

How to Support Technology Use in the Elementary Classroom

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Abstract

A technology survey was conducted in a small British Columbia urban school district. The objective was to determine the districts' elementary teachers' support needs, beliefs, and technology adoption stage with regard to the integration of technology in their classrooms. From the data collected, I have provided an additional source of information that could enhance my district's future technology plans. Specifically, the data provide additional information on how the elementary teachers in the District believe the integration of technology can be supported in this District. Past research has found numerous interconnected factors that influence the level of integration of technology in today's classrooms. The analysis of the survey responses indicated that in this District elementary teachers most frequently identify their level of technology adoption at level 5 (adaptation to other contexts), recognize there is a need for a school-based technology support person, and that the teachers need to experiment with technology-enhanced curriculum before they are comfortable with it. The teachers have the technology skills and believe in its usefulness to foster student success; however they lack the knowledge to integrate technology throughout the curriculum. The results from the survey suggest that future district technology plans incorporate professional development activities and support structures that recognize their elementary teachers' identified needs, beliefs, and present adoption level in order to encourage the integration of technology in the elementary curriculum.

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Introduction

Since the introduction of the personal home computer over twenty-five years ago, society has looked to teachers to implement the use of technology in their classrooms. In 1996, the British Columbia Ministry of Education created the document, Information and Technology K-7. The standards in the document, although not considered Prescribed Learning Outcomes (PLOs), are provided as a guide to districts on how technology could be implemented. The forward states,

It is still expected that students will gain the knowledge, skills, and attitudes described in this document but it is expected that the teaching and learning will be integrated across all other subject areas. Information and communications technology is a tool to support and enhance student learning. The learning outcomes described in this document should be incorporated into all of the learning students are engaged in. (Ministry of Education, Province of British Columbia, 1996).

In May, 2005 the Information and Communications Technology Integration (ICTI) Performance Standards, Grades 5 to 10 were also published by the BC Ministry of Education. The intended purpose of the standards is “to support teachers and students as they use technology to enhance learning across the curriculum” (BC Ministry of Education, 2005, ¶ 1). The United States Department of Education (U.S. DOE) also included provisions for technology integration in the classroom to improve student learning in the “No Child Left Behind Legislation” (U.S. DOE, 2006a). The department struck a plan to encourage the use of technology in schools. “The National Education Technology Plan is meant to help motivate and incite technology-driven transformation” (U.S. DOE, 2006b ¶ 4). In British Columbia (BC),

elementary teachers are encouraged to use the ICTI Performance Standards, however it does not include curriculum that is mandated, or PLOs. Within the standards it states, "In order to implement the ICTI Performance Standards, teachers need only to access products that are currently available in their schools." (BC Ministry of Education, 2005, ¶ 5) As well the document stipulates, "The ICTI Performance Standards have been developed for voluntary use in BC schools." (BC Ministry of Education, 2005, ¶ 6) No direct funding to implement the use of the ICTI Performance Standards is provided for the acquisition of equipment and technology personnel in BC classrooms. Instead, each district is provided with funds to support its general operating budget. "Boards manage and allocate their allotment based on local spending priorities. In addition, the province provides capital costs and funding for special programs through supplemental government funds." (BC Ministry of Education, 2007, ¶ 2). Districts then have the flexibility to determine the allocation of these funds (M. Ekelund, personal communication, 2007).

In School District 28, technology plans include financial support in the way of up-to-date computers and basic software tools as the primary focus of the plan (M. Ekelund, personal communication, 2007). This project includes data collected from a survey of School District 28's elementary teachers that asked the teachers to suggest what additional technology supports they feel are necessary to increase their use of technology in their classrooms. The survey also examined their beliefs about the use of technology by their students. The results of this survey will be presented with a review of current research literature on the factors that may influence the use or

lack of use of the readily available technology in elementary schools. It is anticipated that the results of both the survey and the research review will help the District that is part of this study have a better understanding why technology use in its elementary classrooms continues to be at a low-level.

The BC Ministry of Education has created voluntary Performance Standards for ICTI. The use of a Mentorship program is encouraged to support ICTI. Within the Mentorship document there is repeated reference made to district initiatives, yet no indication is given to how these initiatives might be funded other than through existing district technology plans (Ministry of Education, 2002). With the current District funding formula, are such programs sustainable? The U.S. government has established goals and set aside funds to support educators in their efforts to integrate technology. "From the back office to the classroom, schools of the information age will need to effectively employ technology to better meet the needs of students, parents, teachers, and administrators." (U.S. DOE, 2006b ¶ 2). Research in the area of technology integration indicates the U.S. government, educators, and parents believe technology is a vital part of providing premium education (Andersson, & Streith, 2005; Becker, 2001; Ertmer, 2005; Liu & Huang, 2005; Wai-kit.). Do District teachers also believe technology use is vital? If high-quality education includes the integration of technology in the curriculum of today's classrooms, then why have researchers predicted the continued under utilization of technology in schools (Cuban, 2001a)?

In recent years I have observed technology use which includes once-a-week visits to the school lab where students freely access such programs as Kidpics®, Number Munchers®, Cross Country Canada®, and All the Right Type®. Teachers may use technology to perform administrative tasks or to create worksheets for their students. Office staff and the principal may use programs such as BCESIS® and Excel®. How do District elementary teachers describe their level of technology use in their classrooms? Do the District's teachers have the skills necessary to implement the recommendations set out in the ICIT Performance Standards? Do teachers believe technology can influence student achievement in ways traditional practices do not? Last, what needs do teachers express with regard to equipment, technical support, and professional development to implement the use of technology in their classrooms?

During my more than twenty years of teaching elementary school in a small urban BC school district, I have explored the use of technology with my students as well as for administrative purposes. Since technology was first introduced in my district, I have seen funds allocated to the acquisition of technology tools such as computers, LCD projectors, Internet access to video streaming, and educational programs to support struggling learners. I have had conversations with fellow educators about how technology is being used and underused in our elementary schools. How can this lack of technology be explained in this District? An examination of recent research in this area may help to answer this question.

I begin with an examination of research on the factors that may influence the use or lack of use of the readily available technology in elementary schools. Without such information, technology and its potential to foster student achievement may continue to be under utilized. Has the support given to the use of technology tools by teachers and their students been adequate? Could money have been better spent? Cuban (2001a) states, "Although there is much talk of respecting teacher expertise, recognizing exemplary teachers, and appointing occasional teachers to blue-ribbon commissions, most teachers historically have had little say in designing and implementing technology plans"(p. 183-184). As this District formulates its future plans for the acquisition of new technologies, the data collected through this project has given elementary teachers the opportunity to identify what additional areas of support they see as necessary to integrate technology effectively in their classrooms. As well, I asked District elementary teachers to express what beliefs they hold towards the use of technology in their elementary classroom.

Statement of the Problem

Access to computers for elementary teachers in School District #28 is relatively equal. The majority of classrooms in the District have at least one computer in each classroom to be shared between the classroom teacher and his or her students. As well, each school is provided with a computer lab of 24-30 computers. Each computer in the school has a reliable Internet connection. Many schools have an LCD projector available to support multimedia presentations. The majority of teachers have a working understanding of technology devices and

software. Does this mean meaningful integration of technology will logically follow?

Many policy makers assume this progression will occur. Cuban (2001a) does not agree. He stated that policy makers need to look deeper than just adding more resources and providing professional development for their educators. Cuban emphasized, "[Classroom teachers] ask practical questions about the details, logistics, and worth of new technologies in their classrooms. Their questions must be openly asked and answered" (p. 183). For districts looking to enhance their technology plan, this may then mean the inclusion of educators on a district's technology committee. I anticipated that this project would provide the school District with information about its elementary teachers' support needs that may help augment the District's technology plan.

Using a questionnaire, the teachers were asked to provide information about their competency, support needs for, and beliefs about the use of technology in their classrooms. The data and its interpretation could provide information that might be used to enhance a professional development plan that supports the teachers' needs as they anticipate how technology use can be integrated effectively. Cuban (2001a) recognized that teachers are ultimately the "gatekeepers" of their classrooms. If technology integration has a connection to increased student achievement, then policy makers need to listen to and respond appropriately to the educators on the frontlines. I asked M. Ekelund, District #28 Technology Coordinator, to consider the question, "What responses would you find particularly useful when making future

technology plans?" He stated, "...since I've already said we largely respond to teachers' needs, I think [the needs responses] would be a good source of information about what teacher needs really are." (personal communication, October, 2007).

The data collected from this project have provided one district's elementary teachers a way to have their needs considered when their district constructs its technology plan. As McKenzie (1999) stated, "When surveys are administered yearly, a portrait of the staff and its professional development needs emerges – a portrait that guides program planning..." (p. 86). The findings from the survey data and interpretations of this researcher are one source of information that provides the District's Technology Coordinator information that could be considered when future District technology plans are made; plans that might incorporate the direction of funds towards hardware acquisition, human infrastructure, and additional professional development support.

Rationale and Significance

When a school district constructs its technology plan, teachers' input may help to strike a balance between what technology equipment is needed in its schools and what human infrastructure is required (McKenzie, 1999). Teachers can be asked what they require to implement the use of new technologies so that what McKenzie labels "screen saver disease ...failure of schools to actually use their network or computers to any meaningful extent..." (p. 1) does not continue. Classroom teachers' voices can help to enhance the use of available technology resources and professional development opportunities that will assist them in finding ways to

integrate technology in all curricular areas. By surveying one district's elementary teachers, I was able to gather data in the areas of their present job-related technology use as well as technology use by their students, technology use frequency, beliefs about technology, and technology support requirements. The teachers were given the opportunity to identify the types of support they believe they need and to express their beliefs around the use of technology to support curriculum goals.

Organizational Framework

When discussing the lack of technology integration progress in today's classrooms, researchers have put forward numerous theories. Several factors have been revealed as having an influence on technology integration. A shortlist of these factors include teachers' pedagogical beliefs, other curricular concerns or pressures, infrastructure support, technology access, technology interest level, experience of teachers, teacher competency, and time pressures (Angeli & Valanides, 2005; ChanLin, n.d.; Cuban, 2001a; Ertmer, 2005; Liu & Huang, 2004; Norris, Sullivan, Poirot, & Soloway, 2003; Sime & Priestley, 2005). I used these factors as a framework for my literature review. I have also explored the perceived connection between improved student achievement and technology integration.

A U.S. national technology survey questionnaire (Becker & Anderson, 1998) was the driving force behind the development of a survey of teachers' professional technology use and beliefs about technology's place in elementary classrooms. *Teachers and Technology: A Snap-Shot Survey* (Norris & Soloway, 1998) provided the foundation for the survey protocol used in this study. A modified version of Norris

and Soloway's survey was distributed to all elementary teachers in one school district. The protocol included questions concerning their present job-related technology use and technology use by their students, frequency of technology use, beliefs about technology use, and technology support requirements. The survey employed forced-choice questions.

Research Questions

The project conducted used data collected from a survey of one district's elementary teachers. The survey results helped to address the following questions:

1. What types of support do teachers identify as requirements to integrate technology in curriculum activities?
 - a. Do teachers express a need for additional time to adjust teaching strategies to integrate technology effectively?
 - b. Do teachers express a need for additional time to improve their technology skills to integrate technology effectively?
2. What beliefs do teachers hold towards the use of technology to address curriculum outcomes?
 - a. How do teachers express the relationship between new technologies and the changing roles of schools and teachers?
 - b. Do teachers recognize that technology can be used to foster student success?
3. How do teachers describe their level of proficiency using technology?

- a. What level do teachers identify they have achieved using Norris and Soloway's (1998) six stages of adoption of technology?
- b. What is the frequency of computer use by teachers?
- c. What is the frequency of Internet use by teachers?
- d. In what locations do teachers use technology for professional related activities?
- e. How do teachers receive information about teaching with technology?

I conducted an interview with the School District's Technology Coordinator to answer these questions:

1. What is the role of the School District's Technology Coordinator?
2. What is the District's technology implementation plan for its elementary schools?
3. What is the present focus of technology use in the District?
4. To what extent is technology integration occurring in the District's schools?
5. How does the District support technology integration?
6. Has the Ministry's direction in the area of technology integration, affected the District's technology plan?

Limitations and Delimitations

A technology survey of elementary teachers was completed. A limitation of the project was the willingness of teachers to complete and return the survey in a timely fashion. The survey was conducted during the fall term, a very hectic time of year for teachers. The elementary teaching staff was asked to complete of a questionnaire that might take up to 20 minutes. To encourage teachers'

participation, a covering letter explaining the purpose of the survey accompanied each questionnaire. A second limitation was the survey utilized self-reporting by teachers; therefore, their responses might have been influenced by their perceptions and awareness of technology use in schools. A pilot study of the questionnaire was not conducted; therefore, a further limitation of the survey was the interpretations of the questions made by the responders may not have been that which the researcher intended.

A delimitation of the study is the population under study was limited to elementary teachers in one school district. A second delimitation was the survey was conducted in the fall and distributed through the teachers' school mailboxes. Teachers may not regularly check their mailboxes or attach significance to filling out surveys that are delivered via internal mail delivery. To encourage support for the survey at the school level, the Superintendent contacted the elementary principals via email to garner their support for the survey and to promote it to their staffs.

A personal interview with the School District #28 Technology Coordinator was used to provide background information around technology use in elementary schools. Data from this interview provided the researcher with the District's present technology goals. During the interview, the coordinator was asked to comment on the funding structure for technology tools and support in the District. His willingness to participate openly was contingent on his knowledge considering his position. The conclusions reached by this project will have limited application to secondary schools in the District as well as to elementary schools in other districts.

Definitions of Terms

- BCeSIS: British Columbia Enterprise Student Information System; a centrally hosted, web accessible common student information system
- ICT: Information and Communication Technologies
- ICTI: Information and Communication Technology Integration
- District: the northern school district where this research took place (SD No. 28)
- Low-level technology uses: word processing, Internet research, email, teacher-centered practices, “learning from technology” (Ringstaff & Kelley, 2002)
- High-level technology uses: spreadsheets, presentation software, digital imaging, student-centered learning, “learning with technology” (Ringstaff & Kelley, 2002)
- Constructivism: student-led learning, self-directed learning, learning by doing, learning facilitated by the teacher
- Instructivism: teacher-led instruction, direct instruction, traditional instruction, passive learning
- Best practice: with regards to technology integration, this may include multiple uses of technology that enhances the learning of curriculum outcomes (Dias & Atkinson, 2001), employs self-directed learning, or learning with technology
- First order Change: change in the tools used, but not the belief system; in technology adoption stages this would look like acquiring new

technical skills but using them to teach using an instruction method familiar to the teacher

- Second order Change: change in belief system; an example would be a pedagogical shift in teaching style from instructivism to constructivism.
- Ministry: BC Ministry of Education
- U.S. DOE: United States Department of Education
- Focus Group: a group of teachers coming together to discuss similar interests; i.e., integration of technology in elementary schools
- Educators: teachers, administrators, student support staff, teacher support staff
- SES: Socio-economic status

Literature Review

In this review, I present a summary of research that examines the factors that may explain the continued low-level use of technology in today's classrooms. The foundation for one research study is a U.S. National Survey conducted by Becker and Anderson (1998). The study asked teachers, principals, and technology coordinators to answer questions that were used to examine the connection between teaching philosophies, uses of technology, and *best practices*. One of the categories of questions examined teaching philosophies ranging from *instructivist* to *constructivist*. A second category analyzed factors influencing the frequency of computer use by students and teachers. Areas scrutinized in this second category included access to computers, socio-economic status of students, variety of software used by frequent computer-using teachers, and professional engagement of teachers. A third category of questions asked teachers to express their primary objectives for computer use.

The literature review to for this study further explores the theories proposed in Becker and Anderson's research. I have included research that attempts to establish a connection between teachers' pedagogical beliefs, their attitudes about the use of technology to support these beliefs, factors recognized as having an effect on the level of integration of computers, and the professional development relationship required for technology integration. I also explored student achievement and its connection to the use of technology.

Historical Perspective

In BC, the Ministry of Education does not have a prescribed technology curriculum for K-7 students. The separate curriculum which contained the technology PLOs published in 1996 is no longer referred to as an Integrated Resource Package (IRP). Instead it is now intended as a resource to be used in conjunction with other prescribed curricular areas. Direct funding for technology use in BC schools is not provided. Each school district is provided operating funds from the Ministry of Education. Individual districts then determine the allocation of these funds to district priorities. For example, the District that is the focus of this project traditionally directs from one to two percent of its yearly funds to support technology use in the District (M. Ekelund, personal communication, October, 2007).

The BC Ministry of Education has made attempts to establish a technology curriculum. Personnel who work within the Ministry have developed resources and drafts of curriculum in support of technology use. Resources developed in concurrence with some of these initiatives continue to be available online to those who are interested in exploring technology use to meet prescribed curriculum requirements. In 2005, the ICTI Performance Standards were published to support the use of technology in Grades 5-10. There are prescribed curriculums for grade 8-10 in Information Technology and Information and for Communications Technology for grades 11 and 12. However, for many reasons, both political and philosophical, no elementary curriculum has been prescribed to date for use with BC's K-7 students (M. Ekelund, personal communication, October, 2007). As the technology

curriculum was being developed, a debate ensued around the development of a scope and sequence for technology use versus the belief that technology use is more than the development of individual skills (M. Ekelund, personal communication, October, 2007). That is, some educators and curriculum developers believed learning should occur *with* technology not *from* technology (Ringstaff & Kelley, 2002). Teaching with technology, also known as technology integration, may require teachers to change their pedagogy to meet curriculum requirements. Although a technology scope and sequence plan would be easier to implement and fund, it was not adopted due to the contrary philosophy of the curriculum developers. To develop a curriculum that supported the integration of technology, educators and curriculum developers would also need to reconcile themselves with teacher autonomy. It is a teachers' job to meet curriculum requirements, but how they do that and with what resources is not prescribed. As M. Ekelund described it,

You're dealing with teacher autonomy. It is a very complicated basket of worms and snakes all woven together here. I think what happened at the Ministry level is that as they were coming up with this, all of these snakes started appearing and they started to realize how all of these other things are interrelated and how complex it was going to be and it disappeared. (personal communication, October, 2007)

Historically, technology use by BC teachers to meet curriculum outcomes has not been prescribed. A number of technology projects have been promoted by the BC Education Ministry throughout the years. These have included a laptop initiative in 2005 and the Virtual Schools LearnNowBC program beginning in 2006. LearnNowBC is in support of Distributed Learning, providing access to courses

online for rural and urban students and online resources for all BC teachers. In conjunction with the Virtual School Society, BCEd Online provides resources and opportunities for BC teachers to access online support using technology as well as a link to Professional Learning Community online.

The Alberta government addresses the integration of technology throughout all curricular areas (Alberta Government, 2007). Numerous online resources are made available to educators, parents, and students in the area of technology use in Alberta schools. The U.S. Department of Education supports the use of technology in its schools as a means of addressing student achievement (U.S. DOE, 2006a). As well, in the USA a longitudinal study was conducted, the Apple Classrooms of Tomorrow (ACOT) initiative, from 1985 to 1998. This study was followed by a National Survey of 4,000 teachers titled, *Teaching, Learning, and Computing in 1998*.

Longitudinal Studies

The Apple Classrooms of Tomorrow (Apple Computer Inc., 1995) longitudinal study's guiding question for the first ten years was, "What happens to students and teachers when they have access to computers whenever they need it?" In 1988, the connection between technology use and changing teacher practices from teacher-lead to student-centered was recognized by the ACOT project. An investigation into the relationship between learning and computer use also began at this time. In 1990, research results guided the development of learning environments that support the integration of "collaboration, communication, and

the construction and expression of knowledge" (p. 5). In 1991, inquiry focused on changes in teachers' beliefs and practices related to their computer use, how students' learning changed, and how teachers used technology to structure student-centered learning environments. Apple Classrooms of Tomorrow (ACOT) researchers suggested a professional development process that supports the changing beliefs and practices of teachers using technology as a tool for learning (p. 7). Student improvement was noted both on standardized tests and in other areas not measured by traditional methods. Improvements were found in students' behaviour, attendance and attitude (p. 10). Some other areas in which students demonstrated higher level skills were communication, representation of knowledge, collaboration, independence, and use of technology (p. 10). Teachers were found to question their traditional beliefs and practices as they were guided by mentors, observed real life lessons in ACOT classrooms, and were given time to reflect on what they learned while participating in the ACOT Teacher Development Centers (p. 19). With regard to changing teachers' beliefs and practices, the researchers stated,

"...the technology itself is a catalyst for change—encouraging fundamentally different forms of interactions among students and between students and teachers, engaging students systematically in higher-order cognitive tasks, and prompting teachers to question old assumptions about instruction and learning" (p. 12).

Ertmer (2005) found a connection between the integration of technology and a teacher's belief in constructivism. Sandholtz and Reilly (2004), identified five stages through which teachers progressed (p. 16). At the ACOT Teacher Development

Centers, a teacher support network was provided. The support included a “constructivist learning environment” for teachers, “situated staff development,” “time for reflection,” “specific plans for change” and “immediate and ongoing follow-up support” (p. 19). The research and data that came out of the ACOT initiative have provided a vehicle for many subsequent research proposals (Timeline, pp. 4-6).

In her doctoral thesis, Colbum (2000) presented an overview of some of the previous discussion around the lack of technology use in schools. There has been a debate on how technology should be used in schools, however “...few doubt that it must be used” (p. 3) in today’s developing world. The author suggested that some tension exist among technology advocates, which may be due to disagreement around the definition of technology literacy (p. 6). Today’s students are required to attain goals different from those of their parents. Society expects a future workforce that demonstrates higher-order thinking and problem solving skills rather than just the memorization of facts (p. 8). The advocates of technology use in schools believe in its potential to address these goals (p. 9). However, there is debate about whether technology and its applications in schools will be able to achieve this dream.

Colbum posed four questions that plague teachers, parents and school districts that pour vast amounts of money into technology hardware and software. The questions revolved around the value of computer use to improve student learning and problem solving skills (pp. 9-10). Colbum explained,

To make optimal use of technology involves much more than simply acquiring the latest hardware and software for a school or classroom, it is also a matter of believing that it will be a useful tool for teachers and students. It is a matter of linking belief with knowledge and applying it to practice (p. 10).

In order to support teachers as they begin to integrate technology in their daily practices, Colbum believed the education community must have a better understanding of how teachers make pedagogical changes and changes in practice (p.11). Colbum's research examined the ongoing transition toward technology integration of one grade 5-12 school (pp. 13-14). Her study set out to answer four key questions:

How would these teachers make this transition? What kind of supports would they need to effectively integrate technology? What challenges would arise for classroom teachers and administrators as they attempted to initiate this new instructional model? Would their beliefs and/or practices change? (p. 14).

Cuban (2001a) provided a view of the historical reform movement in education and its connection to what schools are now facing with the push toward the use of technology and its assumed potential to address lagging student achievement. Cuban affirmed, "...reformers believe that education is a solution for both individual failures and larger social problems" (p. 1). He also stressed it has historically been the position of "school activists" that the solution to society's economic and social shortcomings could be found inside the walls of schools (p. 7). Today's policymakers believe "...no tool is better suited for those economic ends than computers" (p. 11). In addition Cuban suggested,

Securing more and better computer technologies for schools, so that they can operate more efficiently and faster and support better teaching and learning, has been touted by corporate leaders and public officials as a splendid way to reform schools according to the market-driven agenda of the past two decades (pp. 11-12).

Cuban also stated the particular driving force of the reform agenda is to provide increased access to “new technologies” in schools. He defined “new technologies” as hard as well as soft infrastructures in schools. Examples of hard technologies refer to wiring, computers, software, disk players, presentation projectors, and digital cameras. Examples of soft technologies are technical and maintenance support for equipment and professional development for teachers (p. 12). The motivations behind the reform movement, Cuban explained, were profits made from equipment sales to schools, the belief that technology use will provide a speedy solution to the old problem of providing a future workforce prepared to be successful in an ever-changing global market, the view that technology is a catalyst for a revolution in teaching practices (teacher-lead to student-lead), and the provision of equal access to technology for all of society’s children will guarantee the development of technical skills and therefore equal employment opportunities in the future (p. 12).

With increased access to “new technologies,” reformers believe schooling will be transformed (p. 13). Cuban (2001a) discussed three underlying goals and assumptions held by those in support of increased access to technology in schools:

1. “Make schools more efficient and productive than they currently are” (p. 13).

2. "Transform teaching and learning into an engaging and active process connected to real life" (p. 14).
3. "Prepare the current generation of young people for the future workplace" (p. 15).

The underlying assumptions these supporters hold, asserted Cuban (2001a), is that providing funding to increase students' and teachers' access to technology will lead to greater student use of technology and therefore greater student achievement. Ultimately, greater student achievement will provide a future workforce prepared to meet the economic challenges of the global economic marketplace (p. 18). Cuban set out to examine technology use in the Silicon Valley School System. He explained this setting was ideal because of the abundance of new technologies (pp. 18-19). Cuban's intention was to explore "...whether the reformers' assumptions have materialized as predicted" (p. 18).

Cuban (2001a) also examined the assumptions made by technology promoters of "new technologies" in schools. Although computers are now found everywhere in schools, he believed the goals of this group have yet to be met and in all likelihood will not occur anytime soon. He asserted that there has been no evidence to show that technology access has led to greater teacher or student productivity, a revolution in teaching and learning practices (a move to project-based, student-centered), or that computer literacy has lead to higher wages for graduating students (pp. 178-179). This lack of progress, Cuban suggested, may lead policy makers to push for more reform and policy prescriptions to speed up the

process (p. 179). "Techno-enthusiasts" may continue to tout a push for increased access to technology as a catalyst for eventual change. Other reformers may take the position that technology will not influence what is occurring in schools until the way schools have always been organized and structured is changed (p. 180). "The Teacher-Led Technology Challenge Project (TLTC) was presented by the author as one example wherein some attempt was made to address factors identified in research as determinants of the integration of technology in curriculum (pp. 184-190). Cuban recognized the goals of the techno-promoters were met during the project; however he questioned whether the progress made toward technology integration can be sustained now that "hard" as well as "soft" infrastructure funding has ended. In addition, he noted that no measurement was made available to determine whether there was any correlation between computer use and an improvement on standardized tests (p. 187).

Cuban (2001a) recognized that many teachers and students have accessed technologies, acquired new skills, and used technology creatively. However, he asserted that the amount of money and time spent on increasing access to "new technologies" has not met the techno-promoters predictions of greater academic achievement, integration, or transformation of teaching and learning (p. 189). He stated, "...without considerable changes in school organization, respect for teacher expertise, and the distribution of decision-making authority among teachers, administrators, and policymakers" (p. 189) little will change in regard to technology use in schools.

Cuban (2001a) felt the historical social purpose of schools has been forgotten by reformers, and until this is recognized the investment in "new technologies" will matter little (p. 190). The author's advice was,

Therefore educators must ask whether spending our limited educational funds to sustain technology will bring us closer to the larger democratic purposes that are at the heart and soul of public schooling in America? When difficult public choices must be made, policy decisions should be informed by the past, situated in the present, and measured against the overriding civic purposes necessary for a democratic society (pp. 194-195).

Cuban (2001b) examined the reasons behind the underutilization of computers in today's schools. As he has previously stated in his book, *Oversold and Underused* (2001a), he sees two camps at work in the school system, the "techno-enthusiastic policy makers" and the "Critics". He suggested that the "techno-enthusiastic policy makers" lay the blame on teachers for the limited use of technology in classrooms (Introduction, ¶ 3). In contrast, "Critics" believe limited use is rampant because research has not proven computer use has any relationship to increased student achievement (What Can Be Done, ¶ 2). Cuban stated most teachers who are avid computer users outside the classroom and believe that computers have the potential to improve teaching and learning also continue to be low-level users in their classrooms. Cuban suggested three reasons for this lack of technology use in schools: inflexible workplace, outside demands on the teachers' time and focus (meeting academic standards, standardized tests, subject area demands), and unpredictable technologies (no funding for on-site technical support) (Introduction ¶ 9-11). How might these factors be addressed? Cuban stated,

“Making changes in what teachers do in their classrooms requires paying attention to the daily workplace conditions and constant external demands, and the inherent unreliability of the innovations themselves” (What Can Be Done, ¶ 8). This attention might mean governments providing, or attaining from private sources, additional monies to allow school districts to hire on-site technicians, reduce class size, provide longer class periods (100-minute periods) and reduce class assignments for high school teachers from five to four (What Can Be Done ¶ 4-5).

Student Achievement and Technology Use

Has technology been proven to engage students actively in their learning? If technology is proven to both improve student achievement and motivation, will teachers integrate technology in their classrooms? Researchers continue to attempt to answer these questions. Waxman, Lin, and Michko (2003) brought together a body of research in their meta-analysis of technology’s effectiveness. Their analysis found evidence that research has shown a small, positive, and significant effect on student outcomes (p. 12). The authors, however, qualified this statement with their disappointment in the lack of quality of the research in this area (p. 13). They went on to stress the need for more and better research in the area of technology’s effectiveness on improving student outcomes when compared to traditional means of instruction (p. 15).

Ringstaff and Kelley (2002) also conducted a survey of research in the area of technology use in education. Their survey focused on the specifics of how technology is used and for what purpose it is employed. These authors made a

distinction between learning “from” technology and learning “with” technology as they selected the research they included as part of their survey (p. 2). When computers are used to improve basic skills and knowledge, this is considered learning “from” technology. Learning “from” technology might also be seen as low-level use of technology. Computers used to promote higher-order thinking and creativity, or learning “with” technology, could be referred to as high-level uses. Ringstaff and Kelley’s findings suggested that when students learn “from” computers there is an increase in students’ scores on standardized tests (p. 5). Although this analysis may satisfy accountability agreements between school districts and the Ministry of Education, classroom teachers may not be fully satisfied with such research evidence. Educators may be more convinced by evidence that technology use addresses the whole student learning process.

Research in the area of learning “with” technology, Ringstaff and Kelley (2002) stated, is harder to measure since no adequate tools have been developed that can determine a student’s higher-order thinking skills. Therefore, technology’s impact on high-order thinking is uncertain (p. 7). However, as other researchers indicated, there are a number of conditions or factors that are recognized as having an impact on the development of students’ higher-order thinking skills. Learning “with” technology was shown to improve a student’s motivation, self confidence and self-esteem, attitude toward learning, attendance, independence, and engagement (pp. 8-9). Studies also indicated that learning “with” technology can encourage teaching practices that are associated with a student-centered learning

approach (p. 10). Under these conditions, technology use in the classroom can be presented to educators as a useful tool that may help to focus their teaching on improving students' learning through the development of their higher-order thinking skills (p. 11). There is a potential to employ technology use in classrooms to promote student learning when educators and policy makers recognize "...technology is a means, not an end; it is a tool for achieving instructional goals, not a goal itself" (p. 1).

The Apple Corporation (Apple Computer Inc., 2002) summarized six research sources that support their belief that, "...effective integration of technology into classroom instruction can and will result in higher levels of student achievement" (p. 1). The improvements in student achievement were organized into four areas. These were: "Mastering Fundamental Skills," "Becoming Proficient Users of Technology," "Preparing Students with 21st-Century Skills," and "Motivating Students to Higher Levels of Achievement" (p. 1). Research from ACOT indicated that students who participated in their programs were engaged by technology and spent increased time practicing basic skills which resulted in improvements in their writing, reading, and arithmetic skills (p. 2). Findings from a study conducted by the U.S. Department of Education supported this contention (p. 2).

ACOT research indicated that as students became proficient technology users they were able to express their ideas and knowledge in professional quality work and take pride in sharing with others. As well, the researchers concluded that programming could be individualized for students through the use of technology,

thus improving their desire to learn (Apple Computer Inc., 2002, p. 2). A North Central Regional Educational Laboratory (NCREL) source indicated students given the opportunity to use technology "...gain a deeper understanding of complex topics and concepts and are more likely to be able to recall information later in life..." (p. 3).

The ACOT program saw an improvement in student attendance, a decrease in the dropout rate, and improved motivation to learn (Apple Computer Inc., 2002, p. 3). As well, students who participated in the program were more likely to go on to college (p. 3). The ACOT project research discussed in the ACOT literature review was heavily supported by programs that provided laptops at school and home computers for the participating students. As well, data used as evidence to support the beliefs of the Apple Corporation were largely taken from studies relating to their sponsored school program, ACOT. To substantiate these findings and generalize to all student populations of technology users, it would be necessary to locate additional research concerning student achievement and technology that does not rely on a laptop program and does not employ the ACOT model.

In the course of their study of two San Francisco Bay Area high schools, Peck, Cuban, and Kirkpatrick (2002) set out to determine how technology has affected the students' school experience. They suggested four ways student learning is affected by computer use in schools which encapsulate "educational technology enthusiasts'" vision for computer use in schools. To assist the analysis of the data collected, the four ways student learning may be affected were: (1) "Ensure that all

students are computer and technology literate," (2) "Offer improved educational resources in order to increase student academic achievement," (3) "Change the nature of education" from teacher-centered to student-centered practices," and (4) "Provide select students with high-tech skills in order to satisfy student, school, and business interests and needs" (p. 474). The study examined the reality of what was occurring at these two schools in comparison to the "techno-promoters'" dreams (p. 474). The data collected showed a large majority of teacher participants were not using computers as part of their classroom instruction and did not require their students to use them to complete assignments; therefore, most students' technology literacy and academic achievement were not impacted by computers. Teachers were observed to use computers to support their teacher-centered practices and for administrative tasks therefore, "the pedagogical revolution sparked by technology is still waiting to begin" (p. 478). Peck, Cuban, and Kirkpatrick discussed the possibilities of why computer use in these two schools fell short of the "educational technology enthusiasts'" vision. As other researchers such as Becker (1998) and McKenzie (2001) outlined, these factors may include teachers' pedagogical beliefs; teachers' lack of technical competency; the isolated atmosphere of a teacher's day and the inability to observe innovations occurring outside his or her classroom; time constraints, including length of class periods and preparation required for technology rich lessons; unreliable technology; the pressure felt by teachers to cover a dense curriculum and improve student outcomes; and the value of using technology to assist with accomplishing these goals (pp. 478-479).

Protheroe (2005) examined previous research literature with a desire to answer the question, "Is there evidence that using technology leads to higher levels of student Learning?" (§ 1). Protheroe suggested that the relationship between student achievement and technology use is clouded by uncontrollable variables in the field of education as well as the nature of the methodology chosen by researchers. (§ 2). Variables cited range from unclear goals for technology use in schools to the lack of testing procedures to support the measurement of higher-order thinking skills of students (§ 2). Protheroe suggested that previous research can guide future directions for the development of the technology-student achievement relationship. Research examined by the Protheroe indicated that technology can increase students' basic skills through drill and practice (§ 5). Protheroe's citation of the conclusions found in the review conducted by Stratham and Torell (1996) is problematic since each is premised with conditional phrases such as "When properly implemented," "When used appropriately," "Students from computer-rich classrooms," and "among populations of at-risk students" (§ 6). How might these results be generalized to the majority of classrooms that do not meet these conditions? How would schools meet these standards? What does "properly implemented" and "used appropriately" really mean? Protheroe also offered that research conducted by Sivin-Kachala, Bialo, and Rosso (2000) found "effective use of technology" led to improved student attitudes (§ 7). Again what is "effective use of technology"? Protheroe made reference to research that identified factors that suggest a positive impact on achievement. (§ 9). As Cuban (2001a) also theorized,

Protheroe's research indicated teachers and their teaching practices were in large part the key to whether technology use was implemented in ways that improve student achievement (§ 9). Protheroe discussed research that was in support of Becker and Anderson's (1998) opinion that teachers' use of constructivism in conjunction with technology has the potential to improve student learning (§ 10). As McKenzie (2001) also contended, Protheroe stressed that technology use is best done in the course of careful planning that is guided by the curriculum and the students' needs (§ 12).

Schacter (1999) also scrutinized research on the impact technology education on student achievement, analyzing five large scale studies and two small scale studies conducted on or before 1999. Schacter summarized the effectiveness of computer technology and its impact on student achievement.

...[S]tudents with access to:

- (a) computer assisted instruction, or
- (b) integrated learning systems technology, or
- (c) simulations and software that teaches higher order thinking, or
- (d) collaborative networked technologies, or
- (e) design and programming technologies

show positive gains. (p. 9)

Schacter (1999) suggested seven dimensions to aid in the development and planning for technology use in schools. These "Seven Dimensions" were reminiscent of factors and determinants discussed by ChanLin (n.d). Some areas they included

were a focus on the learner, a teacher's competency with technology, computer availability, community culture, and accountability to the curriculum (Schacter, 1999, p. 10).

McKenzie (1999) presented a connection between the use of technology in classrooms and authentic problem solving by students. McKenzie proposed that technology can support students' learning in a variety of ways, from guiding the writing process to developing independent, original thinking. McKenzie related how students who participate in the "right" technology program will become "infotectives," that is they will demonstrate the ability to analyze, organize, and take insightful action based on data retrieved from technology sources (p. 40). The author suggested, "If students are engaged in learning, then teachers do much less teaching. They act more like coaches, helping to shape student efforts through a mixture of modeling and suggesting" (p. 18). However, McKenzie did recognize that for the most part this type of "good" teaching is not occurring. The author explained, "...the bulk of our teachers lack the support, the resources, or the motivation to bring these intruders into the classroom core" (p. 1). McKenzie believes under the right circumstances technology use will promote student achievement (p. 2). However, "Until classroom teachers are shown how new technologies can improve the way students learn and think in social studies, science and math class, they are unlikely to sit up, take notice and make significant use of these new tools" (p. 2).

Pedagogical Beliefs

Becker (2001) analyzed data from a 1998 U. S. National Survey of teachers' use of technology to identify factors that influence teachers' use of technology. One factor emphasized that teaching philosophies predisposed teachers to the level of use of computers in their classrooms. That is, teachers who practiced instructivist teaching were less likely to use computers than were those who used constructivist methods. Riel and Becker (2000) looked at the same data together in an effort to determine "how pedagogical beliefs, practices and computer use of teacher leaders compared to other teachers" (p. 7). From the data, they recognized the teacher participants fell into four categories; Teacher Leaders, Teacher Professionals, Interactive Teachers and Private Practice Teachers (p. 1). The authors concluded "Teacher Leaders" and "Teacher Professionals" who were frequent computer users also practiced student-centered teaching (constructivism). They hypothesized that this relationship may be explained in either of two ways. Leaders in education believed that students learn best in a student-centered classroom so they cannot ignore the computer as a tool that supports this philosophy. Leaders are also high users of computers and because they use this tool with their students they recognize the effect on their students' learning and adopt the philosophy of constructivism in their daily teaching practices (p. 33).

Ertmer (2005) took Becker's analysis one step further and examined the relationship between teacher's pedagogical beliefs and the process of change required to adopt technology in their classrooms. She described the change in a

teachers' belief structure as second-order change, "...change that confronts teachers' fundamental beliefs and thus, requires new ways of both seeing and doing things" (p. 26). Although there are data to support the increased use of computers in schools, Ertmer stated this use is of the low-level variety. Low-level use of technology is also first-order change. Low-level uses are associated with traditional instruction and high-level uses are associated with constructivism (Becker, 2001). Ertmer went on to state, "If educators are to achieve fundamental, or second-order, changes in classroom teaching practices, we need to examine teachers themselves and the beliefs they hold about teaching, learning, and technology" (p. 27).

Cuban (2001a) also recognized the connection between a teacher's fundamental belief system and technology use when he predicated that, given time, the progression of technology use will continue. In the end, however, "...every student, like every worker, will eventually have a personal computer. But no fundamental change in teaching practices will occur" (p. 196). Becker and Ravitz (2001) found that data from the 1998 U. S. National Survey indicated that Cuban's beliefs may be true only in the present, but when teachers and schools meet certain underlying conditions this may not indefinitely be the case. Becker and Ravitz highlighted six factors that would encourage greater integration of computers in more curricular areas. Of particular note is their identification of the importance of teachers being professionally engaged and using the constructivist model of teaching. Ertmer declared that, "It is imperative that educators increase their

understanding of and ability to address teacher beliefs, as part of their efforts to increase teachers' technology skills and uses" (p. 37).

In an ethnographic study, Barnes (2005) identified factors that influenced teachers' implementation of a new technology curriculum in the Australian state of Queensland. Barnes also conducted a literature review which "...revealed a gap in knowledge in regard to factors that influence teachers to change curriculum content and practice" (p. 8). Although the technology curriculum referred to in the study is not necessarily related directly to computer use, Ertmer (2005) noted similar factors as having an influence on the process of change teachers undergo as they move toward the integration technology in their classrooms. Barnes noted five factors that promote the need for change in the technology curriculum. These included: "flagging student interest" in the traditional technology program; "external curriculum" changes outside the country (USA and New Zealand) as well as in other Australian states; "Supportive School Environment" including the school-based administrator, peer support, materials, and professional discussions; "Personal Renewal," a teacher's desire to form "new beliefs, [develop] knowledge and [learn] new skills"; and "Leadership Styles" which were identified as either "trendsetter" or "promoter" (pp. 10-12). Barnes explained that the factors identified were evident during the time of curriculum change which was "non-systemic" (p. 13). It is interesting to note this that technology integration in British Columbia's school system can also be described as non-systemic because there is no prescribed technology curriculum for K-7. As Angeli and Valanides (2005), Ertmer (2005), and

Kanaya, Light, and Culp (2005) also indicated, Barnes asserted that support given to teachers who are addressing change in content and practice, needs to be addressed through the provision of professional development opportunities that employ time needed for teacher reflection and learning by doing.

Dias and Atkinson (2001) examined the stages of change through which teachers progress, as they begin to adopt technology in their classrooms. They identified the "best practices in teaching with technology," and the role administrators play during the teachers' change process (p. 2). Dias and Atkinson suggested that the change process teachers using technology in schools are moving through is a "transformational one" (p. 3). "Adult learning is transformational when individuals progress from some new idea or skill to a changed state of knowledge or functioning" (p. 3). As McKenzie (2001) indicated, leaders in education should recognize the learning process adult learners require to move successfully through the stages of change. From their study, Dias and Atkinson discovered, "...that best teaching practices and best technology integration practices go hand-in-hand" (p. 6). Dias and Atkinson concluded, "Findings from our study and prior research seem to indicate that frequent computer usage combined with multiple uses of technology tied to constructivist strategies may constitute best practices as related to technology integration" (p. 9). Knowing the conditions in which technology is most readily implemented by teachers, the authors suggested that before administrators begin an evaluation of a teacher's performance, they need to consider the teacher's development stage, the professional development opportunities that are available to

facilitate progress through the stages, and how they will offer the necessary support and guidance (p. 10).

Vannatta and Fordham (2004) suggested three teacher attributes that may predict technology use in classrooms. The results from this research differ from previous studies (Becker 2001; Becker & Anderson, 1998; Becker & Ravitz, 2001; McKenzie, 2001). That is, the authors explained, a teacher's philosophy of practice, traditional instruction verses constructivism, was not included in their regression model (p. 261). Instead their study indicated that a teacher's time commitment to developing his or her practices and technology skills, openness to change, and amount of technology training were the best predictors of technology use in the classroom (p. 261). The authors also recommended that future research might look at the reliable measurement of the quality and method of technology use as well as its influence on student outcomes (p. 262). Vannatta and Fordham also stated, "...this study suggests that technology training should be provided in conjunction with activities that facilitate the teacher dispositions of openness to change and time commitment to teaching improvement" (p. 263).

Considering these bodies of research, policy makers, such as those in the provincial ministry and school districts, may need to consider teachers' fundamental belief systems when addressing the issue of low-level technology use in their schools.

Professional Development

An additional research focus of technology use by classroom teachers examines how and when to tackle the issue of teacher change. Barnes (2005) identified two factors that he believed may need to be addressed by policy makers to encourage second-order teacher change. One of the factors is personal renewal. "Effective personal renewal may be initiated by the provision of a sustained period of professional development that encourages reflection and self-discovery" (p. 16). The focus of professional development in the area of technology needs to move away from skills development to one which supports the integration of technology (Sandholtz & Reilly, 2004). After examining research from the Apple Classrooms of Tomorrow project, Sandholtz and Reilly maintained that teachers progress through five stages of evolution as they learn to use technology. They also felt that teachers may have difficulty moving out of the first and second stages, entry and adoption. "With a perception that they must be technical experts and without adequate support, teachers may go for years using technology only in limited ways" (Sandholtz & Reilly, p. 492). In their study, Sandholtz and Reilly identified five factors that allowed teachers to focus more on instruction and less on technology. One factor highlights a focus on a teacher professional development program. "Teachers learn in a constructivist environment that includes opportunities to explore, reflect, collaborate with peers, work on authentic learning tasks, and engage in hands-on, active learning" (p. 505). When teachers in the study were able to focus more on integrating technology into their practice and less on acquiring technology

skills, they progressed more quickly through the five stages of "instructional evolution" (Sandholtz & Reilly).

The level of a teacher's professional involvement has also been a focus of research. Becker and Ravitz (2001) discussed the relationship between the frequency and variety of computer use and the level of a teacher's professional involvement. They discussed three levels of professional involvement; private practice, interactive teachers, and professionally engaged. Becker (2001) found that professional leaders are six times more likely than private practice teachers to be high-level users of technology (Findings Section, ¶ 2). Riel and Becker (2000) suggested, "...there are huge differences between professionally engaged teachers and "Private Practice" teachers in both the frequency and method of how they use computers" (p. 33). Riel and Becker also advocated a change in how professional development is provided for teachers. They recommended a structure that would allow teachers to support one another and share their experiences on a continuous basis (p. 34).

McKenzie (2001) wrote about how to promote teachers learning and valuing the use of new technologies through professional development. His suggestions focused on the design of professional development programs that would encourage high-level uses of technology by classroom teachers. McKenzie suggested, "Lead districts are finding that adult learning, curriculum development projects, and informal structures are proving powerful in promoting recurrent use aimed at deep curriculum integration" (Introduction, ¶ 3). McKenzie stated that the focus needs to be on how adults learn and concentrated on curriculum and literacy rather than on

networks and software. The phrase “putting the cart before the horse” is used by McKenzie to highlight the usual approach school districts have taken when undertaking technology planning. He stated, “The focus should be on teaching and learning strategies that make a difference in daily practice—on activities translating into stronger student performance” (Introduction, ¶ 9). McKenzie also suggested the design of networks should be the final stage in the process of addressing technology use in schools. McKenzie outlined an approach to professional development that focused on strategies and projects that would allow teachers to learn by doing, working together in informal groups with adequate technology support staff. He advocated changing the organization of schools in a way that minimizes the need for teachers to work in isolation as they develop lessons that integrate new technologies. McKenzie stressed that districts need to slow down the allocation of resources towards new technology and instead adopt a plan that fosters professional development based upon adult learning strategies (The Bottom Line, ¶2). He also proposed an approach to technology integration that focuses not on the use of software but fostering student success. School districts examining why technology continues to be underused in their schools could use the suggestions made by McKenzie to enhance the types of professional development opportunities related to technology in their districts. On a daily basis, classroom teachers recognize the focus of every strategy and activity must be on learning. School districts will also need to address this underlying belief as they develop and adopt a

technology plan. McKenzie wrote, "Learning is the goal. Technologies are mere delivery systems "(Defining the Challenges, ¶ 5).

Not unlike McKenzie (2001) and Becker (2001), Ertmer (2005) outlined three strategies that consider teachers' experience with technology as the guiding principles for professional development related to technology. She supported the premise that beliefs formed from personal experiences, vicarious experiences and social-cultural influences have the most potential to influence the level of technology used by classroom teachers. Angeli and Valanides (2005) indicated that technology's impact on learning is directly related to whether "...teachers know how to use ICT to promote student thinking, expression, and knowledge building" (p. 292). The authors described an instructional system design model (ISD) used with preservice teachers in phase three of the study. The model included three 3-hour workshops on a computer program, lectures on knowledge bases (science topic, teaching methodology), instructors modeling of the program to be used by the preservice teacher in their lessons, and instructors discussing with the preservice teachers the ways the program could be used with students in student-centered lessons. The preservice teachers who participated in this phase of the study demonstrated statistically significant greater technology competency in using ICT to support constructivist learning than did preservice teachers who participated in the first two phases of the study using other ISD models. Ertmer (2005) made professional development recommendations to school personnel to address encourage greater integration of technology. The recommendations included

ongoing public conversations, teachers working in small groups to examine new practices that would produce change in their classrooms, chances to observe exemplary practices in colleagues' classrooms, and gradual introduction of technology tools beginning with those that support their current practices (first-order change). Afterwards, professional opportunities should be made available that would address the development of a new set of pedagogical beliefs and ongoing support with new technology.

Littrell, Zagumny, and Zagumny (2005) also conducted a study of preservice teachers' use of technology. The authors evaluated whether preservice teachers' computer experiences were determinants of their use of technology as part of their instructional practices when they became teachers with their own classrooms. Littrell, Zagumny, and Zagumny wondered, "If a teacher education program stresses primarily basic computer competencies, will the graduates of the program use technology for more than classroom management as inservice teachers?" (p. 39). A survey of 168 K-12 teachers was conducted to collect data on the teachers' instructional technology use (p. 40). Three major barriers to technology use were identified. The number one barrier found was a lack of time followed by a lack of access to equipment, then a lack of training (p. 42). Use of computers for classroom management was predicted by computer self-efficacy, access to a printer in the classroom, and computer assistance from a co-worker. Use of technology for instructional purposes by teachers was related to the teachers' computer self-efficacy, receipt of State Technology Grants, and use of online resources for

instructional development purposes. At the time, preservice teachers received adequate training to use computers for classroom management tasks when provided with access to a printer from their classroom. This study implied the lack of use of technology for instructional purposes may be due to low-levels of computer self-efficacy (p. 45). As Angeli and Valanides (2005) also noted, Littrell, Zagumny, and Zagumny suggested that preservice training can address this issue through the modeling of technology instruction by faculty members and requiring the use of technology by students for assignments and practicums. The study suggested "...education students should engage technology when and where IT is needed. The 'job' of education faculty is to facilitate this interaction and not direct it in stand-alone courses" (p. 45).

O'Bannon and Judge (2004-2005) conducted a project funded by the U.S. Department of Education titled "Partnerships Across the Curriculum with Technology" (ImPACT). The intention of the project was to address the instruction of technology integration for inservice teachers. Participants included preservice teachers, their mentor teachers, and teacher education faculty supervisors from the University of Tennessee (p. 197-198). O'Bannon and Judges attempted to determine whether mentor teachers' technology use improved as a result of their participation in Project ImPACT (p. 198). The study focused on three of ten of the prerequisite factors identified by the International Society for Technology in Education (ISTE) that were believed to be essential for high-quality technology use by teachers. The three factors were access, professional development, and support. The model also

emphasized two additional factors for their relationship to a teacher's technology use, incentives, and evaluation. The authors suggested that, "The results indicate that participants integrated significantly more instructional technologies in their teaching as a result of Project ImPACT" (p. 209). Focus group comments and post-treatment-survey data indicated "access to technology was vital to the change brought about in the practice of employing technology in instruction for the mentor teachers" (p. 207). Professional development activities in their own school, working with preservice teachers, and sharing with fellow mentors and facilitators were highlighted as elements that were beneficial for mentor teachers while undergoing change (p. 208). Post-treatment survey responses indicated the significance of a support system (technical, instructional, school administrator, and the community) for promoting technology integration (p. 209). The recommendations to schools from the study included: increasing access to computers for students and teachers and addressing this by budgeting for new equipment as well as maintenance, introducing a professional development plan that includes hands-on activities, promoting student-centered instruction, providing support that includes technicians and administrators, allowing time for collaboration with peers, and encouraging a community that values the potential for technology's use as a tool to support curriculum (p. 10).

Rudnesky (2007a; 2007b) provided a school administrator's view of technology integration in schools. He encouraged fellow administrators to demonstrate leadership in the area of the integration of technology. He stressed that

school leaders must lead by example and “use the power of technology to lead their schools” (Be Passionate..., 2007a, ¶ 5,). Along with (Cuban, 2001; Becker, 1998; McKenzie, 2001), Rudnesky finds that his school has “put the cart before the horse” and acquired the tools of technology before planning how they will support the school’s curriculum goals, let alone having a professional development plan for the integration of technology (Be Passionate, 2007a, ¶ 10, 12, 14). The author believes the movement towards the integration of technology starts with himself, the administrator, “ By doing your own research and walking the walk, you will set an example that will make significant gains in lining up your technology goals and objectives with your school goals and objectives” (Never Ask...¶ 3).

Rudnesky (2007a) implemented a peer mentoring program as a professional development method in his middle school. The goal of the program was to provide a comfortable, secure environment for teachers at different stages of implementing technology use in their classroom. Rudnesky felt the broken promises referred to by Cuban (2001a) were the result of teachers not receiving the kind of training that emphasized the use of technology to support curriculum (Rudnesky, 2007a, Why Training? ¶ 1). “We knew one of the most important components was to have curriculum drive the technology and allow teachers to see the relevance. We knew we had to make the connection for the teachers” (Why Training? ¶ 4). After reviewing the literature, Rudnesky’s school developed a peer mentoring program that focused on one-to-one relationships. “Our initial ten-month research project concluded that using peer mentoring accelerated the training, broke down barriers,

promoted collegiality, and motivated teachers to use technology more” (Why Training? ¶ 7).

Ringstaff and Yocam (1994) examined the Apple Classrooms of Tomorrow (ACOT) Teacher Development Model. The authors claimed that school reform focusing on the development of students higher-order thinking, collaboration and analytical skills can be best addressed by allowing students to “construct their own knowledge” using different technology and programs as tools. Ringstaff and Yocam suggested the ACOT model and students’ use of technology were a catalyst not only for change in how students learn but also how today’s teachers might structure their classrooms. The staff development model addressed both a teacher’s acquisition of technology skills and the change in instruction from teacher-lead to student-lead (constructivism) (p. 1).

Ringstaff and Yocam (1994) believed that technology integration and a constructivist mode of teaching continued to be slow because the model of staff development was insufficient (p. 1). Teachers participating in the ACOT model were offered both short practicums during the school year and summer institute opportunities. The characteristics of the program included: real classroom experiences where lessons were modeled and participants worked with students, flexibility to choose activities of interest to build their own knowledge, reflection time including small group discussions and journal responses, assistance and time to develop technology-related projects of their own, and immediate follow-up support once the participants returned to their home schools. The ACOT Teacher

Development Model stressed a team approach to change. The team members included at least two teachers at one school, the school's principal, and an ACOT coordinator. The goal was for the team members to provide immediate ongoing support and assistance with planning. The authors believed research supports their claim that technology is a catalyst for changes in teachers' teaching practices and can also be credited with influencing students' levels of interest in acquiring knowledge, taking responsibility for their own learning, and improving achievement (p. 24).

Ringstaff and Yocam believed the ACOT Teacher Development Model had positive results, "...many participants feel a greater sense of professional efficacy; they return to their classrooms with the belief that they can—and will—make positive changes in their classrooms and schools" (p. 24).

Kanaya, Light, and Culp (2005) collected data from 237 teachers who participated in the Intel Teach to the Future Program in 2001 and 2002. This program used a train-the-trainer model as a K-12 professional development program. The program focused on the integration of software applications and technology skills delivered to students using a project-based teaching methodology (p. 317). The data from the study were examined to determine factors that were found to influence the outcomes of the program. The data indicated that the pedagogical usefulness of topics was a predictor of the basic outcome. Teachers' perceptions of pedagogical usefulness, intensity (less than three months), and teacher preparedness were all significant predictors of optimal success. The authors found that the intensity and program content determined the success of a

professional development program focused on increasing teachers' technology skills, and changed how teachers delivered curriculum that utilized technology integration (p. 325).

Current research implies that district technology plans need to include opportunities for teachers to have input into not only what types of activities best promote technology use, but also who leads these activities. Teachers need to create their own materials that they perceive as relevant to where they are now in the change process (Kanaya, Light, & Culp, 2005).

Additional Influencing Factors

Much of the literature in the area of integration of technology focuses on identifying factors that influence the level of technology use by today's teachers. There is a body of literature that attempts to isolate distinguishing factors that may explain the low-level use of technology by classroom teachers. Some researchers looked at a specific factor such as access, pedagogy, professional development, or the change process. Other researchers have found that no one factor can explain the continued lack of technology integration in today's classrooms. In this section, I will discuss research that has identified interconnected factors as possible explanations for this ongoing dilemma.

Becker (2001) presented a description and analysis of data retrieved from *Teaching, Learning, and Computing US* (1998), a national survey of 4000 grade 4-12 teachers. He categorized analysis of into six areas: (1) Students' frequency of use of computers broken down into subjects taught by teachers; (2) teachers' professional

engagement and their computer use; (3) the socio-economic status of student; (4) types of software used; (5) teachers' objectives for student computer use; (6) and teaching philosophy, instructivist or constructivist. Becker's analysis suggested four major predictors of the level of computer use by teachers in their classrooms. The teacher characteristics that appeared to be the strongest predictors of high-level use of computers in the classroom were, "...technical expertise, access to classroom computers, professional engagement, and to a lesser extent, having a constructivist philosophy, that predicted their use of these constructivist-compatible uses of computers during class" (Overall Prediction...p. 2, ¶ 2). Student characteristics were found to be of lesser value for predicting computer use in the classroom.

A questionnaire developed and implemented by ChanLin (n.d.) established five major factors that influenced the level of technology use. These included social impact (influences from within the teacher's world), curriculum concern (how to use technology to meet curriculum objectives), environmental support (student access to computers, teacher access to support personnel, and funding for resources), interest and experience (a teacher's personal experience, knowledge base, use in teaching), and personal need (a teacher's personal growth for oneself or family). For those involved in designing technology plans for a district, ChanLin's study illustrated teachers' perceptions of what requirements were needed in order for meaningful use of technology to occur in schools (p. 292). ChanLin stated, "The study results suggested that positive attitudes toward social, curriculum, and environmental

supports, as well as the fulfillment of personal needs, are more likely to help teachers gain positive interest and experience in technology integration" (p. 292).

Liu and Huang (2005) identified classroom teachers' attitudes towards technology use in schools as a factor that influenced the level of technology integration in their classrooms. They believed that a teacher's level of concern plays a role in the attitude the teacher had toward the use of technology. Liu and Huang employed Hall, George, and Rutherford's (1977) seven stages of concern as a theoretical basis of their study (p. 37). The authors recommended how to address the apprehensions felt by teachers throughout all the stages of concern. These suggestions included providing teachers with information and examples for technology integration throughout the curriculum, incentives and time for teachers to attend related workshops and courses, and evidence and explanations of all the benefits of technology use in the classroom (p. 46).

Karagiorgi (2005) employed Fullan's theory of the implementation process to analyze what had occurred at ICT pilot schools in Cyprus. "...the main purpose is not to judge the effectiveness of the innovation itself. Rather, the study aims to demonstrate how the schools responded and adapted to the experimental programme so as to highlight the conditions necessary for sustainable innovation" (p. 20). Karagiorgi maintained that a failed innovation can often be explained as one that has not recognized that how people experience change plays a role in whether the implementation of the innovation is successful (p. 20). "Change comes about through interaction and compromise at the school level, rather than through

technological planning or political conflict at the system level" (p. 20). Two main implications of the study were a need for further discussion of the contribution of ICT to learning, and a recommendation that issues of technical support be addressed immediately so that teachers can concentrate on their intended role as planners and implementers of technology integration throughout the curriculum (pp. 30-31). Further, the author recommended a "...move towards a people-oriented dimension, emphasizing the meanings of participants, and to develop a strategy of implementation focusing on school-specific concerns rather than superficial knowledge and assumptions" (p. 31).

Sime and Priestley (2005) gathered data from student teachers' observations during their practicums. They grouped the data into three categories, physical (ICT resources), human (teachers' attitudes, perceived competence, and training), and cultural (community attitude towards ICT) (p. 136). The four factors identified were beliefs, experience, resources, and community (p. 132). As Liu and Huang's (2005) research also purported, the student teachers noted teachers' and schools' attitude towards technology use was strongly influenced by its perceived importance for teaching and learning. "...many of them hold strong convictions that the school as a culture has the power to influence individual teachers' practice and beliefs" (p. 138). This theory was also supported by Cuban (2001), ChanLin (n.d), Karagiorgi (2005) and McKenzie (2001).

Wai-kit, Andersson, and Streith (2005) also examined factors that affect teachers' "intention towards computer technology use." They hypothesized that a

teacher's acceptance of computer technology directly relates to his or her perception of its usefulness, ease of use, and how important their acceptance of its use is to others in his or her community (p. 389). The data indicated that teachers' belief that computers are useful had a direct significant effect on their "intention towards computer technology use" (p. 392). There is an indirect relationship between this intention and ease of use. The authors suggested that teachers will not only use computer technology because it is easy to use, but also believe in its usefulness (p. 392). The third hypothesis of the study that teachers' tendency to use computers is affected by others' opinions of its use, was not proven (p. 392). The data collected from this study were from a survey completed by student teachers. The authors suggested that future research would need to determine if similar data will be collected from practicing teachers. As well, some of the students' opinions are based on observations in settings where computer technology use was not mandatory. Therefore, the results may have been different in a mandatory setting especially in the way that community beliefs might have influenced the "intention towards computer technology use" (p. 393).

Bebell, Russell, and O'Dwyer (2004) analyzed data collected as part of the Use, Support, and Effect of Instructional Technology Study (USEIT) (2003). For the purpose of their study technology was defined as "...computer-based technologies and included personal computers, LCD projectors, and Palm Pilots" (p. 49). The authors adopted a fresh perspective when they analyzed teachers' technology use. They stipulated that previous research had combined teachers' use of computers

into a single generic measure. Bebell, Russell, and O'Dwyer's research instead measured teachers' use of technology using multiple measures. That is, they measured each type of use separately. The authors asserted this way of looking at teachers' use of computers gives a clearer or truer picture of what was really happening in the K-12 classrooms of today (pp. 49-53). As well, Bebell, Russell, and O'Dwyer argued that from one research study to another the differences between the definition of technology use have also been overlooked especially by educational leaders who might use the findings to guide their technology planning. The authors suggested, "The analyses presented here demonstrate the value of conceiving of technology use as multiple categories or types of use rather than a single generic construct" (p. 59). The implication was that when measuring teachers' use of technology there were vast differences between the types of technology use and its effect on student outcomes as well as teaching practices (p. 59). Data reported from some previous research may combine a teacher's uses of technology from email to classroom uses that encourage student-centered projects into one generic measure. Clearly these uses may not have the same effect on student achievement; and in the case of email use may not be easily observed by those responsible for evaluating a teacher's use of technology. (p. 60). "For this reason, the traditional methodological tool of classroom observations would fail to capture these activities in an evaluation or research study" (p. 60). Bebell, Russell, and O'Dwyer's study shows how the patterns of technology use depend on the both the definition and measures of technology use (p. 59).

Whereas there appears to be little difference in the frequency with which teachers use technology based on their years teaching, their school type, or across most subject areas (except mathematics) when a generic measure of technology use is employed, important differences appear when technology use is examined as a multi-dimensional construct (p. 59).

Bebell, Russell, and O'Dwyer suggested that the results from their study demonstrated that the issue of technology use is complicated. Therefore, when districts are evaluating teachers' use of technology or designing technology programs, they may need to collect "...information about the specific types of teachers' technology use rather than simply measuring its generic presence or absence" (p. 59). In addition, principals may need to evaluate more than whether teachers use technology or not, but instead examine how teachers are using technology (p. 59).

Colbum (2000) observed, interviewed, and assisted four teachers at a grade 5-8 middle school as they began to move towards the integration of technology in their classroom curriculum. During her work as a researcher, she was also employed at the school as a technology facilitator whose job was to work with the school's staff as part of a support team. From her review of previous research, the author came to believe that, "Understanding how technology is optimally integrated into a teacher's curriculum, therefore, is an important step to facilitating more widespread, appropriate use of technology in schools" (pp 246-247). Colbum found the move to technology integration has a positive impact on how teacher participants in her study viewed themselves and how their classroom practices

changed (p. 252). The teachers also saw a change in how students learned and in the quality of their work (p. 252).

Colbum(2000) concluded that support was a key to the change process for the participants in her study. The support took many forms. The technology team (network manager, technology facilitator, librarians, principal) provided research to support their belief in the benefits of technology for both students and teachers (pp. 246, 253). The facilitator's role included working with the classroom teacher to make curriculum and technology connections and to provide opportunities for technology instruction and one-on-one assistance in the classroom or lab when requested (p. 253). Opportunities for discussion and reflection with colleagues were also provided by the technology team (p. 254). One limitation of the research included the recognition that the qualitative data provided only an explanation of how and why the four teachers in the study chose to pursue technology integration in their classrooms; it did not address why other teachers did not (p. 255). The author's intention in conducting the research was not only to provide a description of what she observes in this setting but also to propose a theory in the form of a hypothesis statement,

When teachers are provided with support, they put forth great effort and persist in order to "get it right" and as they recognize benefits and needs, they allocate time in order to develop expertise and plan to effectively integrate technology into their curriculum, in order to provide the best for their students (p. 254).

With the above-noted support structures in place before beginning a change process and throughout, Colburn believed technology, "...can become an integral piece of the classroom curriculum" (p. 268).

Hartman and Procter (2003) used a focus group approach "...to identify the leadership issues that influence the integration of technology in schools" (p. 1). The themes and factors identified by the educational technology leaders who participated in the focus group implied a need for an integrated model of leadership that incorporated the plans suggested by technology leaders at all levels of the district (p. 13). As McKenzie (1999) also outlined in his "First things first" approach, school district leaders will need to agree first upon a purpose for technology use before the types of technology needed are acquired. Following this, educational leaders may need to recognize and address the constraints of a school district in regard to its technology infrastructure including the affordability of the types of technology required to accomplish their purpose (p. 13). Hartman and Procter noted:

There is a need for leaders who can lead the integration of objectives and methods of the persons and parts of educational organizations so those organizations can make sensible decisions about technology integration that will assist those organizations to attain their objectives (p. 10).

McKenzie (2000) proposed that the lack of government and school district understanding of how change occurs explains the "lopsided planning" for technology tools in schools. McKenzie made claims similar to those of Cuban (2001a) and Becker and Anderson (1998) when he wrote, "...that the billions of

technology dollars spent each year for the past 3-4 years have had minimal impact on the daily practice of teachers across the land and scant impact on how students spend their time in schools" (McKenzie, 2000, Lopsided Planning Section, ¶ 2).

McKenzie went on to outline approaches to change that those responsible for "networking schools" will need to consider in order for the successful use and integration of technology to occur in schools. McKenzie also recognized that "Making good change demands the cultivation and engagement of the key stakeholders within the school community, especially the classroom teachers" (Basic Principles to Guide Change Efforts Section ¶ 5).

Nellen's (2002) explanation for why technology has yet to change education is that people fear change. He presented a three part solution to address this fear of change and its relationship to technology use in schools (Introduction ¶ 2). The first problem to solve lies with the ever-changing and expensive technology acquisition required. The technology here refers to computers, software, and the continual upgrades required after a district's or school's initial purchase. As well, Nellen believed the use of a business model of computer use does not work in schools for various reasons (First Part ¶2). Some of these reasons include the number of users for each computer can be dozens per day, maintenance personnel can be an added expense so the job is often delegated as an add on to a teacher's responsibilities, some schools do not have the electrical capacity to become "wired," and to keep children safe, and filters are added to systems that may prevent obstacles for

accessing good sites as well as the ability to download necessary software (First Part ¶3-5).

The second problem Nellen suggested is the “human element.” He explained this as mainly teachers’ lack of use. The fault for this lack of use, however, he believed is not the teachers. Instead, he ties this lack of use to deficiency in professional development which is tied to lack of funding, unfamiliarity of how to use technology in school because the majority of teachers did not use it during their own school years, lack of support from administrators, and modeling from principals. The author stated, “The human element is myriad and very complex in the failure of successful implementation of the computers in our classrooms” (Second Piece ¶ 1-5).

The third part of the problem was described as school culture. Nellen believes over the past 300 years schools have changed very little. As well, he suggested there is not a clear, agreed-upon purpose for schools. Today teachers are asked to cover a vast and growing number of learning outcomes. Nellen stated, “We may expect a great deal from schools, but we don’t provide much financial support to accomplish those lofty tasks” (Third Component ¶ 1). This, explained Nellen, is why many have observed very little change in teaching methods and how students are expected to learn. “Lots of studies are made about schools and change without much implementation or practice. School culture and educational policy is [sic] the result of pedagogy and politics” (Third Component ¶ 2).

Additional factors that encourage frequent use of computers in classrooms include a small number of topics covered in depth by the teacher, long class periods of at least ninety minutes when technology is integrated, and at least five computers housed within the teacher's classroom (Becker & Ravitz, 2001). Norris, Sullivan, Poirot, and Soloway (2003) also found "...the reason for non-use lies not at the feet of teachers, but rather in the very real lack of access to the technology, e.g., having one computer in the classroom is *not* access..." (p.1).

The body of research I have presented here highlights numerous pieces to the puzzle of why researchers have found low-level technology integration remains the norm. Although each study labels and categorizes its findings differently, five themes encompass most, if not all, of the identified factors. These themes are teacher's perceived level of competence using technology (skills), perceived usefulness of technology use to deliver curriculum content, access to physical and human technology resources, the kind of professional development or technology training, and community culture expectations for technology use.

Contribution of this Study

From this review of research literature on the subject of technology integration, it is clear that the issue of low-level technology integration is a concern for many scholars. As educators begin to recognize that technology use does have the potential to develop higher-order thinking skills in today's students, the next issue to address is not only how to promote its use by classroom teachers, but also how to support teachers as they develop the necessary pedagogy and technical skills

required to meet learning goals and student outcomes. What should be addressed first? Where should resources be focused? McKenzie (1999) promoted the redesign of professional development programs. Cuban (2001a) believed school districts need to address the concerns of the “gate keepers,” classroom teachers, before we can expect movement toward high-level uses of technology in today’s schools. Ertmer (2005) suggested that high-level uses of technologies by teachers require a second-order change because of the necessary need to change teaching practices. In order for this change to occur, she believed educators need to address teachers’ beliefs before expecting an increase in teachers’ technology use in their classrooms. Barnes (2005) supported McKenzie’s (1999) position that professional development opportunities need to include support systems that allow time for teachers to reflect and learn by doing.

In order for technology programs to recover from the “screen saver disease” described by McKenzie (1999), fundamental changes may be required to school districts’ technology plans. Research has indicated that the driving force for any plan must be student learning (McKenzie, 1999; Protheroe, 2005; Ringstaff & Kelley, 2002). As well, school districts may need to redesign professional development programs in order to promote high-level uses of technology in their schools (e.g. ACOT, 1995; Angeli and Valanides, 2005; Barnes, 2005; Ertmer, 2005; Kanaya et al., 2005; McKenzie, 1999, 2001). This redesign would support teachers as they experiment with changing teaching practices and beliefs. As McKenzie (1999) stressed, “We also need to provide more informal support structures such as

mentors, coaches and “just in time help” that often do more to promote risk taking and growth than formal class offerings” (p. 7).

Research Method

My intention was to examine one District's elementary teaching staff's present level of technology use with its students. A survey provided teachers an opportunity to express their needs and beliefs around technology use. As well the data collected provides technology personal with the snapshot of the present level of computer and Internet use by its elementary teachers and their students. This information may help to add to the future technology plans for the District elementary schools. The technology coordinator could review what support the district's elementary teachers identified as needs to further develop their skills to provide their students with opportunities to learn with technology.

The project data were collected using a self-administered questionnaire containing closed-ended questions. The use of the survey method dates back to the early censuses (Weisberg, Krosnick, and Bowen, 1996). Fowler (1993) wrote, "...early in the twentieth century, researchers began to write standardized questions for measuring subjective phenomena" (p. 5) Today, the goal of this method is to answer the researcher's questions (Fowler, 1993). Weisberg et al. stated,

Although it is difficult to fit everything a survey can measure into a few categories, most things that surveys are used to measure can be regarded as attitudes (or preferences), beliefs (including predictions and assessments of importance), or facts (including past behavioral experiences). (p. 13)

Weisberg, Krosnick, and Bowen also wrote, "...many researchers believe that the best way to find out what people like and believe is to ask them" (p. 16).

Instrumentation

A modified version of Teachers & Technology: A Snap-Shot Survey Version 3.1 (Norris & Soloway, 1998) was used as the survey instrument for this investigation. Modifications to the demographics section were made to include grade configurations found in the District's elementary schools. As well a section was added to include access to a computer at school for professional-related use by teachers. In the section that included information areas teachers receive about teaching with technology "Resource Person" was changed to "District Technology Personnel." In the needs section the statements were phrased into complete sentences. As well, statement 2 was changed from "Need more time to change the curriculum to better incorporate the technology" (Norris & Soloway, 1998) to "I need more time to adjust my teaching practices to incorporate new technology." The belief section was modified extensively. In statement one "textbooks" was replaced with "traditional print sources." Statements added included: "I believe the role of the teacher will be dramatically changed because on new technologies within 5 years; I believe that I am a better teacher with technology; I take personal time to learn and practice technology skills; I believe there is a need for a school-based technology support personnel; and I find the use of technology be motivating for students." Statements 4 and 5 of the original survey were omitted. In the access to computers section statements related to compatibility of home and computer programs and laptop access were changed to "Number of computers per lab and Internet connections per lab."

The questionnaire gathered data that asked the teachers to describe their present level of technology skills, their level of technology use, their attitudes toward technology use for professional purposes by teachers and by students, and the support the teachers believe is required for teachers and students to use computers and various technology devices for educational purposes. The questionnaire asked for responses to questions in the following categories: (1) Demographics, (2) Teachers' beliefs related to technology's place in elementary classrooms, (3) Needs to support technology integration (professional, technical support, planning time etc.), (4) Present level of technology use by the teacher and his/her students, and (5) Present level of technology adoption by the teacher for professional use. Version 3.1b included demographic questions, a Likert-like section on beliefs, a 5-point scale on the urgency of technology needs, questions about student and instructional time using computers, and a self assessment of each teacher's stage of technology adoptions (see Appendix I).

Research Population

The target population of this project was the elementary teaching staff in the researcher's small urban school district. Teaching staff included both part-time and full-time classroom teachers, teacher librarians and learning resource teachers. The participants were provided with a written description of the purpose of the project prior to their completion of the questionnaire. One hundred twenty-three questionnaires were mailed out to the District's elementary teaching staff.

Procedures

The project, its purpose, and the survey protocol were presented to the District Superintendent prior to the delivery of the questionnaire to participants (see Appendix II). Permission to conduct the survey and an endorsement to do so was received from the District Superintendent (see Appendix III). An introductory letter accompanied each questionnaire and was presented to the District Technology Coordinator prior to conducting the interview (see Appendices IV & V). The cover letter explained the purpose of the project and a brief explanation of the data analysis planned. Data collection took place during the months of September and October 2007. Participants were encouraged to direct any queries regarding the questionnaire to me via District email or telephone. An interview protocol was developed (see questions in the Research Questions section of this document) and used during the interview with the District Technology Coordinator.

In the fall of 2007, the questionnaire was hand-delivered by the researcher to the mail boxes of each elementary teaching staff member, including teacher librarians and learning resource teachers. Completed questionnaires were returned to the researcher via internal District school mail. Email reminders were sent out to individual teachers two weeks prior to the data collection period ending on November 9, 2007. Responses received on or before the completion date were eligible for a prize draw of a restaurant gift certificate. Endorsement from the District Superintendent was emailed to District principals prior to the survey.

An interview with the District Technology Coordinator was conducted in October, 2007. The interview provided information on District procedures and policies, and present and past BC Ministry of Education positions with regard to technology use and funding in the District's schools.

Ethical Considerations

This research project was approved by UNBC's Research Ethics Board (see Appendix VI). Permission to modify and use the survey protocol (Norris & Soloway, 1998) was obtained through email correspondence with C. Norris (see Appendix VII). The purpose of the research project was fully disclosed to the participants in the study. Data were gathered through questionnaires completed by elementary teachers employed by School District #28. As such, letters of permission to conduct the survey were obtained from the School District Board through its Superintendent. Participation in the project was voluntary. Participants were free to decline or withdraw from the research at any time. Because all the participants in the project are members of the BCTF, its code of ethics was respected.

Cover letters included with the questionnaire described how the data would be used and collected for the purpose of a UNBC MEd research project. Teachers and the Technology Coordinator were assured that their participation in the project would not place them at risk personally or professionally. The teachers and the Technology Coordinator were asked to sign a consent form indicating that they had given their informed consent to participate in the study (see Appendices VIII and IX).

The data collected were kept in a secure location and teachers' names were not included as part of the demographics collected. Participants indicated on the consent form their desire to view the results of the data collection and analysis. On their letter of consent, participants were also invited to request a copy of the final project report. The technology coordinator was provided with a draft of a summary of comments he made during our interview. He was also given the opportunity to request any changes. No changes were requested or made.

Questionnaire Results

Data Analysis

An analysis of the responses to the questionnaire commenced when the final responses were received in November, 2007. The analysis of the questionnaire responses was managed using Excel© and included descriptive statistics including frequencies, percentages, means, and standard deviations. As well, a number of analyses of variance (ANOVAs) and correlations were conducted on relevant data. The interview conducted with the District Technology Coordinator was recorded and transcribed using Microsoft Word©. The interview responses were used to provide information in the areas of historical background of technology curriculum in the province of BC and this District, District technology plans around support of technology use, and potential usefulness of the data collected from the questionnaire. The final analysis and interpretations of the data will be presented to the District Technology Coordinator. It is anticipated that the data may be considered when the District technology plans are revised. These plans may include professional development opportunities that support the needs of its elementary teaching staff as they move through the stages of technology adoption.

During analysis of the data a comparison of responses between genders was explored. No significant variability was found between male and female teachers' responses; therefore further exploration was not made. As well, no significant variability was found when separating the participants' responses by age. In

addition, some of the participants chose not to identify their age ($n = 60/67$).

Further analysis that compared responses by age was not pursued.

Response Rate and Participants

The response rate was 54% ($n = 67/123$). Of the respondents who chose to identify their gender 88% ($n = 53/60$) were females and 12% ($n = 7/60$) were males. The questionnaires were provided to the District elementary teaching population ($n = 123$) whose names were identified from a list obtained from the office of the Director of Instruction in October, 2007. The percentage of male elementary teachers was 16% ($n = 15/123$) and 84% ($n = 108/123$) were female. Age groups are shown in Table 1. In Table 2, teaching assignments are summarized. Teachers indicating they had more than one teaching assignment were included in the "other combination" category.

Table 1
Identified Ages of Respondents.

Age Group	Frequency	Percent
50+	27	40%
30-39	16	24%
40-49	10	15%
Not identified	8	12%
20-29	6	9%

Table 2

Teaching Assignments of Respondents.

Grade Group	Frequency	Percent
4-7	23	34%
1-3	15	22%
Learning Resource Teacher	8	12%
Other Combination	7	10%
Librarian	5	7%
K-1	4	6%
3/4	3	4%
K	2	3%

Questionnaire Responses

Support Requirements

What types of support do teachers identify as requirements to integrate technology in curriculum activities?

The teachers were asked to report what types of support they identify as requirements to integrate technology in their classrooms' curricular activities. Responses were given on a scale of less urgent (1) to more urgent (5). In this District, the most urgent needs identified were "Need to be able to try out technology-enhanced curriculum units in my classroom before I am comfortable with them ($M = 4.11$), this included 79% of the respondents indicating either 4 or 5, this need was followed by the response, "Need more software that is curricular-based ($M = 3.85$). The least urgent needs expressed were "Need more access to the Internet for my students" ($M = 2.64$), preceded by the response, "Need more compelling reasons why I should incorporate technology into the classroom" ($M = 2.67$). All the needs are listed in Table 3 in rank order with each of their means and

standard deviations. Figure 1 shows question 10 answer distribution: "Need to be able to try out technology-enhanced curriculum... Figure 2 shows question 12 answer distribution: "Need more compelling reasons why I should incorporate technology..."

Table 3
Needs: Frequencies, Means, and Standard Deviations

Question	Statement	Mean	SD
10	Need to be able to try out technology-enhanced curriculum units in my classroom before I am comfortable with them	4.11	0.88
7	Need more software that is curricular-based	3.85	1.09
3	Need more training with technology	3.79	1.13
11	Need more opportunities to work with colleagues to become proficient using technology-enhanced curriculum units	3.71	1.13
8	Need more technical support to keep the computers working	3.69	1.20
4	Need more training with curriculum and pedagogy that integrates technology	3.68	0.96
9	Need more resources that illustrate how to integrate technology into the curriculum	3.67	0.97
2	Need more time to adjust my teaching practices to incorporate new technology	3.44	1.053
5	Need more access to computers for my students	3.20	1.38
1	Need more time to learn to use computers and the Internet	2.86	1.28
12	Need more compelling reasons why I should incorporate technology into the classroom	2.67	1.28
6	Need more access to the Internet for my students	2.64	1.34

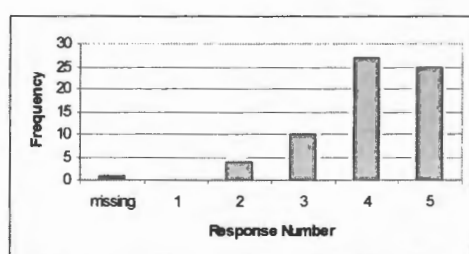


Figure 1. Question 10 Answer Distribution: Try Out Technology.

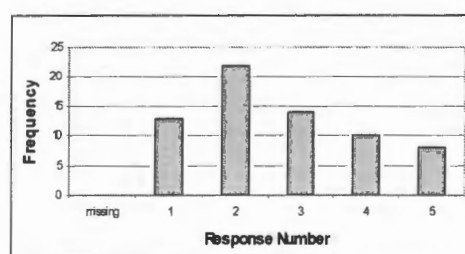


Figure 2. Question 12 Answer Distribution: Reasons to Incorporate Technology.

Using Pearson's product-moment correlation statistic a negative correlation was found between the teachers' response to: "I need more time to learn to use computers and the Internet" and the time teachers indicated their students spent

involved in curriculum related computer activities (two-tailed test, $r = -.248$ $p < .05$). A test of effect size using Cohen's test indicated a small effect size. As well a negative correlation was found between the response to: "I need more time to adjust my teaching practices to incorporate new technology" and the time they indicated their students spent involved in curriculum related computer activities (two-tailed test, $r = -.254$, $p < .05$). A test of effect size using Cohen's test indicated a small effect size.

Teachers' Beliefs

What beliefs do teachers hold towards the use of technology to address curriculum outcomes?

The teachers were also asked to reflect on what beliefs they presently hold towards the use of technology to address curriculum outcomes. Each statement was ranked from strongly disagree (1) to strongly agree (5). In this District, teachers indicated their strongest agreement to the statements "I believe there is need for a school-based technology support personnel" ($M = 4.22$), this included 85% of the respondents selecting either 4 or 5 (agree or strongly agree). The second ranking item was "Technology can help accommodate different learning styles" ($M = 4.21$), and the third was, "I find the use of technology to be motivating for students" ($M = 4.10$). The District's elementary teachers expressed their lowest levels of agreement for the statements: "I believe that traditional print sources will be replaced by electronic media within 5 years" ($M = 2.40$); "I believe that the role of the teacher will be dramatically changed because of the Internet within 5 years" ($M = 2.66$); and

"I believe that the role of schools will be dramatically changed because of the Internet within 5 years" ($M = 2.79$). Using Pearson's product-moment correlation statistic a positive correlation was found between the teachers' response to the statement: "I find the use of technology to be motivating for students" and the time spent by students using the Internet (two-tailed test, $r = .279$, $p < .05$). A test of effect size using Cohen's test indicated a small effect size. There was no significant relationship found between this same belief and time spent by students using computers. The results for all the belief statements are listed in Table 4 in rank order with the means and standards deviations for all the statements.

Table 4
Beliefs: Frequencies, Means, and Standard Deviations

Question	Statement	Mean	SD
7	I believe there is a need for a school-based technology support personnel.	4.22	0.88
10	Technology can help accommodate different learning styles.	4.21	0.85
8	I find the use of technology to be motivating for students.	4.10	0.82
6	I take personal time to learn and practice technology skills.	3.33	1.25
4	I believe that the role of the teacher will be dramatically changed because of the new technologies within 5 years.	3.03	1.10
5	I believe that I am a better teacher with technology.	3.12	1.23
9	Student time on the Internet is time well spent.	2.86	1.02
2	I believe that the role of schools will be dramatically changed because of the Internet within 5 years.	2.79	1.38
3	I believe that the role of the teacher will be dramatically changed because of the Internet within 5 years.	2.66	1.07
1	I believe that traditional print sources will be replaced by electronic media within 5 years.	2.40	1.04

Level of Proficiency

How do teachers describe their level of proficiency using technology?

Sixty-six of the sixty-seven respondents had access to at least one classroom computer with an Internet connection and all 67 teachers had access to a school lab

of 24-30 Internet connected computers. The teachers were asked to consider the time they and their students spent on computer-based activities exclusive of the Internet use and their personal and student use of Internet-based activities for curricular or teaching or administrative activities. The teachers' most frequent response in the student categories was for 15-45 minutes each week for both "Students engaged in computer-based activities for curricular purposes" ($n = 28$) (see Figure 3) and "Students engaged in Internet-based activities for curricular purposes" ($n = 23$) (see Figure 4). The teachers' most frequent response in the category of their use of the computer for teaching or administrative activities was more than 90 minutes each week ($n = 28$) (see Figure 5). The most frequent response for teachers' use of the Internet for teaching or administrative activities was 15-45 minutes each week ($n = 22$) (see Figure 6). Overall, 22% of the teachers reported no computer use by their students and 34% reported no Internet use by their students. Of the sample of teachers 3% reported no use of computers for teaching and administrative activities and 6% reported no use of the Internet for teaching and administrative activities

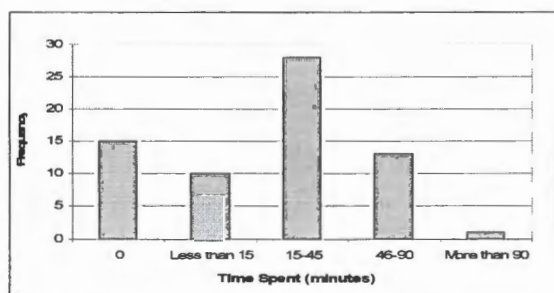


Figure 3. Question 1 Answer Distribution: Students' Computer Use.

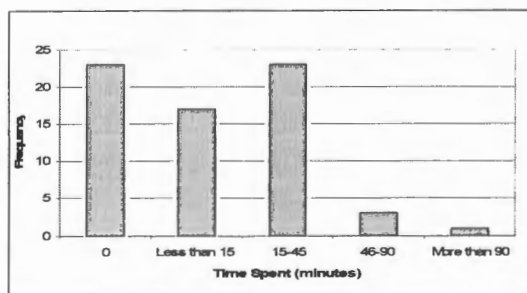


Figure 4 Question 2 Answer Distribution: Students' Internet Use.

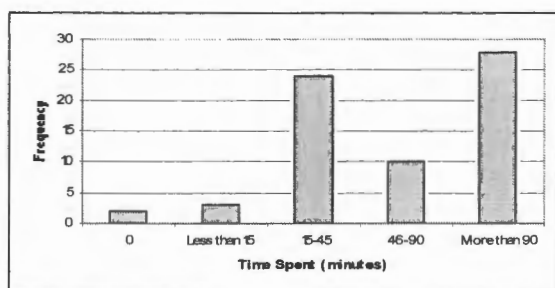


Figure 5. Question 3 Answer Distribution: Teachers' Computer Use

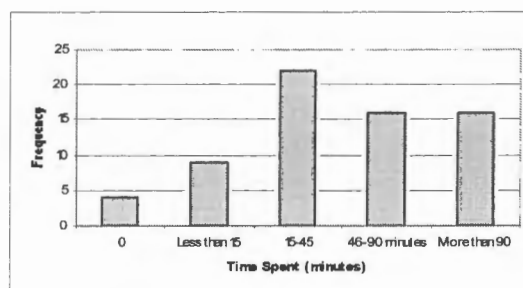


Figure 6. Question 4 Answer Distribution: Teachers Internet Use.

The times primary students using computers or the Internet and intermediate students using computers or the Internet were calculated using responses from teachers who indicated they taught either primary or intermediate students exclusively. Teachers' responses were assigned scores of 0 (zero minutes per week) to 4 (more than 90 minutes per week). There was no significant difference found between the time primary and intermediate students used computers as shown in Table 5. The results for primary students use was $M = 1.5$ while intermediate computer use was $M = 1.8$. An Analysis of Variance indicated that this difference was not significant, $F(1, 42) = 0.63$, $p = 0.43$. Table 6 indicates there was a statistically significant difference for the comparison between primary and intermediate students' use of the Internet, $F(1, 42) = 7.09$, $p < .01$. A test of effect size using Cohen's test indicated a large effect size ($d = .80$).

Table 5

Intermediate and Primary Students' Computer Use

Anova: Single Factor

SUMMARY			
Count	Sum	Average	Variance
23	41	1.782609	1.086957
21	32	1.52381	1.261905

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.735225	1	0.735225	0.628255	0.432451	4.072654
Within Groups	49.15114	42	1.170265			
Total	49.88636	43				

Table 6

Intermediate and Primary Students' Internet Use

Anova: Single Factor

SUMMARY				
Groups	Count	Sum	Average	Variance
IntIntAct	23	32	1.391304	0.885375
PrIntAct	21	14	0.666667	0.733333

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5.764163	1	5.764163	7.090215	0.01094	4.072654
Within Groups	34.14493	42	0.812974			
Total	39.90909	43				

Table 7 shows there was a significant difference found when an Analysis of Variance was calculated between the teachers' time using the Internet or computers and their students' time using the Internet or computers. The differences for both these comparisons were large. For the first comparison, the results for teachers computers use was $M = 2.76$ while students' computer use was $M = 1.63$. An

Analysis of Variance indicated that this difference was significant, $F(1, 132) = 34.72$, $p < .001$. A test of the effect size using Cohen's test indicated the effect was large ($d = 1.02$). For the second comparison (see Table 8), the results for teachers' Internet use was $M = 2.46$ while that for students' Internet use was $M = 1.13$. An ANOVA indicated that this difference was also significant, $F(1, 132) = 49.87$, $p < .001$. A test of the effect size again indicated the effect was large ($d = 1.22$).

Table 7

Teachers and Students' Computer Use

Anova: Single Factor

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
TeaCoAct	67	185	2.761194	1.305744
StuCoAct	67	109	1.626866	1.176843

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	43.10448	1	43.10448	34.72545	2.99E-08	3.912875
Within Groups	163.8507	132	1.241294			
Total	206.9552	133				

Table 8
Teachers and Students' Internet Use

Anova: Single Factor

SUMMARY				
Groups	Count	Sum	Average	Variance
StuIntAct	67	76	1.134328	0.996834
TealntAct	67	165	2.462687	1.373587

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	59.11194	1	59.11194	49.87464	8.44E-11	3.912875
Within Groups	156.4478	132	1.18521			
Total	215.5597	133				

There was a high positive correlation found between teachers' time using computers and teacher's time using the Internet (two-tailed test, $r = .537$, $p < .01$). A test of effect size using Cohen's test indicated a large effect size. There was also a high positive correlation between students' time using computers and students' time using the Internet (two-tailed test, $r = .323$, $p < .01$). A test of effect size using Cohen's test indicated a medium effect size. A significant positive correlation was also found between teacher time on computers and students time on computers (two-tailed test, $r = .257$, $p < .05$). A test of effect size using Cohen's test indicated a small effect size. There was no significant correlation found between teacher time on the Internet and student time on the Internet.

The teachers were asked to identify their present level of the adoption of technology (Norris & Soloway, 1998). The stages range from "Awareness" (stage 1) to "Creative application to new contexts" (stage 6). Respondents who identified

more than one stage were assigned an average of the stages they identified.

Therefore, a respondent who identified themselves as both stage 3 and stage 4 was identified as stage 3.5. The most frequent stage indicated was stage 5: "Adaptation to other contexts" ($n = 25$) with a median response of stage 4: "Familiarity and confidence". Figure 7 shows the distribution of the stages of technology adoption in this District.

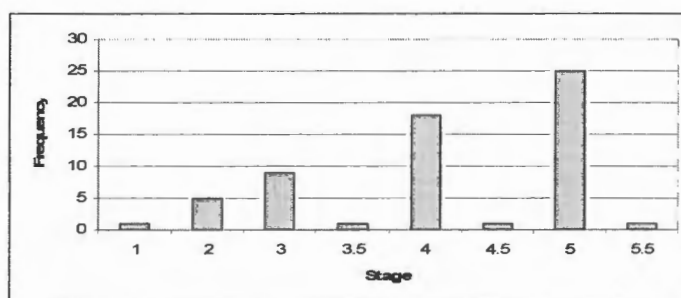


Figure 7. Answer Distribution: Teachers' Technology Adoption Stage.

Two-tailed tests of significance were performed on the correlation between the teachers' stage of adoption and mean times they and their students used computers or the Internet. A high correlation was found between the adoption stage of the teachers and their students' time on the Internet ($r = .323$, $p < .01$). A test of effect size using Cohen's test indicated a medium effect size. A significant correlation was found between the teachers' adoption stage and students' time using computers ($r = .283$, $p < .05$). A test of effect size using Cohen's test indicated a small effect size. A high correlation was also found between the teachers' time using computers and their adoption stage ($r = .354$, $p < .01$). A test of effect size using Cohen's test indicated a medium effect size. A significant correlation was found for

the teachers' time on the Internet and their adoption stage ($r = .288$, $p < .05$). A test of effect size using Cohen's test indicated a small effect size.

The respondents were asked to identify where they receive their information about teaching with technology. The teachers were given six sources to choose from and were asked to identify the percentage of information they received from each source. If each source was given equal consideration, the percentage would be equally distributed at 17%. Table 9 shows the frequency of assigned percentages greater than 17% and the number of responses for each source greater than 50%. Receiving information from peers or colleagues was indicated to be the most likely source. Twenty-six respondents (39%) indicated 50% or more of their technology information is from peers or colleagues. Research journals as a source of technology information were assigned the lowest percentage (zero responses for 50% or more and two responses assigned greater than 17%).

Table 9
Teachers' Sources of Technology Information

Source	Frequency Greater than 17%	Frequency 50% or more
Peers/ Colleagues	21	26
District Technology Personnel	12	11
Internet	18	7
Conferences	17	2
Teacher Magazines	4	1
Research Journals	2	0

Technology Coordinator Interview Results

An interview with School District #28's Technology Coordinator was conducted in October, 2007. The purpose of the interview was to provide background information about the history of technology use in the District, the present District focus for technology use, and future plans for technology use in the District.

Technology Coordinator Role

What is the role of the School District's Technology Coordinator?

The District Technology Coordinator, M. Ekelund, is responsible for supervising four to five technicians. The technicians' responsibilities include installing and maintaining the District's computer systems. As well, the Technology Coordinator allocates funding provided for District technology towards the purchasing of all hardware, software, computers, and peripherals. Ten to twenty percent of the Coordinator's job includes the inservicing of teachers, largely in the use of software. Presently the District is implementing the use of BCeSIS (British Columbia Enterprise Student Information System) by its staff. As a result of this implementation, approximately forty percent of the Coordinator's time is allocated towards training all staff in the use of BCESIS. In the spring of each year, the Coordinator meets with the administration of the District and completes a yearly budget that will be directed towards technology needs in the District. The Technology Coordinator's division of time is "very flexible and fluid." He responds largely to the direction of the District Superintendent.

District Technology Plan

What is the District's technology implementation plan for its elementary schools?

The District's technology plan centers on the ongoing upgrades to equipment. Presently, there is a replacement plan that will insure that all computers in schools will be no more than 4 years old. The District usually plans to purchase 300 computers for its schools each year. Most schools now have an Internet connected lab of 30 computers. The District has installed twelve LCD projectors in classrooms to date. In elementary classrooms, there is usually one computer available to be shared by the teacher and his or her students. Software continues to be updated, including software for use by students with special needs.

At this time there is no general laptop program for use by large numbers of elementary students. The Coordinator feels that such a program is not sustainable due to present funding levels. Currently the District is considering a reconfiguration of its schools, which may allow for experimentation in this area. Reconfiguration would include one middle school. M. Ekelund suggests, "My vision for a middle school would be to put a lot of technology [in]; probably more than a senior school; every time you reconfigure a district it opens up an opportunity" (personal communication, October, 2007).

There is no formal professional development plan that encourages the use of technology by elementary teachers in District #28. At this time, the informal plan includes the "planting of seeds." This includes installation of LCD projectors in some elementary classrooms, workshops on professional development days, and impromptu sessions when requested by a teacher or a group of teachers. There is no

active encouragement to use technology. "Responding to people's expressed needs keeps us busy; it's as much as we can do anyway" (M. Ekelund, personal communication, October, 2007). The District tries to predict future trends and needs by looking outside the district. "A lot of it is just what are people talking about?" (M. Ekelund, personal communication, October, 2007). During the school year there may be three to four areas where there have been requests for additional inservice. These requests provide the focus for District workshops during professional development days or after school. Needs are met and seeds are planted through these workshops. "We do little seed things here and there to get people thinking about it. But generally we don't do a lot of expenditure until we're reacting really to what people really need" (M. Ekelund, personal communication, October, 2007).

District Technology Use

What is the present focus of technology use in the District?

The District Technology Coordinator has seen a range of uses for technology in the District. In some schools the "screens are black for significant periods of time" (M. Ekelund, personal communication, October, 2007). A lab might be used for "random activities," drill and practice with math facts, research, or writing. The Coordinator has seen a lot of PowerPoint use for student presentations. There is a limited use of Excel. The Coordinator is not directly involved in day-to-day uses of technology by elementary teachers or their students; therefore he is not privy to any other extensive projects that may be occurring.

Technology Integration

To what extent is technology integration occurring in the District's schools?

The technology coordinator believes that the integration of technology in elementary schools in the District is limited. "Varying widely from teacher to teacher, increasing slowly," stated M. Ekelund (personal communication, October, 2007). The reasons behind the varying degree of technology integration are numerous. M. Ekelund summarized a number of possible explanations. Teachers may believe that curriculum requirements can be done well without the use of technology. Because technology takes a lot of energy, teachers may choose to stay with what they are familiar. There are a number of demands on teachers' time and teachers "only have a certain amount of energy to devote to this part" (M. Ekelund, personal communication, October, 2007). As well bringing technology into the classroom changes the dynamics of a classroom. Technology use requires a lot of flexibility. "[Integrating technology] also requires excellent classroom management skills to function in an environment that isn't totally predictable. Even if you see [technology use] as a good thing, you feel it as an uncomfortable thing; it doesn't go easy for you" (M. Ekelund, personal communication, October, 2007). Considering the possible complications technology brings to the classroom, and the extra energy required, a teacher may choose not to integrate technology. M. Ekelund explained, "...a teacher's job really is to meet curriculum requirements. [Technology, not being a separate, prescribed curriculum,] makes it an add-on instead of part of the core [curriculum]" (personal communication, October, 2007).

Supporting Technology Integration

How does the District support technology integration?

Technology support is in response to needs expressed by teachers. When a need is expressed the Coordinator delegates the necessary personnel to support the specific need. A technician or the coordinator will help with technical problems with equipment (printer, LCD projector, computer etc.). The coordinator might arrange for an expert in the district to put on a workshop when a specific request is made. In the recent past, the District held focus group meetings two to three times each year. During these meetings interested teachers would acquire new skills such as using a digital camera or creating and maintaining school web pages. The meetings also provided an opportunity for teachers to share their personal experiences using technology in their classrooms and receive suggestions on additional areas to explore. In the past, there was also a part-time teacher assigned to support technology use in elementary schools. The teacher was available on request to support the District's elementary classroom teachers with the use of technology. Focus group meetings and the part-time technology support position are no longer available. As well, the coordinator feels creating a position in each school for a person whose job it is to coach others is not financially sustainable at this time.

Another avenue of support teachers might explore is the District's mentorship program. The coordinator has observed teachers setting up their own conversations with one another to support the use of technology. They may request further assistance from the coordinator as plans are developed but the peer support

relationship is usually already established. He could see possibly offering to extend the mentorship program to further support the teachers' needs. M. Ekelund explained,

"I think that we're giving people a reasonable level of support at this time and it's the sort of level that's sustainable. It may not be enough to get them beyond the hurdle so they would do a lot more; I don't know" (personal communication, October, 2007).

Ministry Direction

Has the Ministry's direction in the area of technology integration, affected the District's technology plan?

M. Ekelund believes the Ministry has not made a strong statement with regards to the integration of technology in schools, "If they did you would see it very clearly in every curriculum" (personal communication, October, 2007). At the moment, the Ministry does not provide direct funding for the use of technology in its schools. Each district is given a set amount of money to support all its programs. In this District, one to two percent of its total funding is directed towards technology (\$300 000 to \$400 000 each year). "Presently, really I think the phrase is "the money is the money"" (personal communication, October, 2007).

At an earlier period, the Ministry began to develop a technology plan. "At some point [discussions] lead to the idea of a development of what we'd say a scope and sequence; I think a number of things killed it. One is cost; once you put something in curriculum you pretty much need to find a way to fund the resources for it. Right now the Ministry gives us no funding for technology specifically" (M.

Ekelund, personal communication, October, 2007). A second stumbling block was the philosophical debate around thinking of technology as a skill set or a tool to be integrated into all subject areas. "The easiest way and cheapest way of dealing with technology is to develop a scope and sequence that teachers can consider as a skill set. And as soon as you start thinking of the idea of a scope and sequence it's taking you away from integration" (M. Ekelund, personal communication, October, 2007). In the end the Ministry decided not to prescribe a technology curriculum for elementary schools.

"It's a very complicated basket of worms and snakes all woven together here. I think what happened at the Ministry level is that as they were coming up with this, all these snakes started appearing and they started to realize how all these other things are interrelated and how complex it was going to be and it disappeared" (M. Ekelund, personal communication, October, 2007).

Due to a lack of Ministry direction, the District has the flexibility to develop its own plans. Although a scope and sequence might have been easier to support, "it might have actually been more work, but you would know what you had to do" (M. Ekelund, personal communication, October, 2007). At this time, the District is participating in small scale pilots initiated by individual teachers who have secured funding from Ministry divisions such as SET-BC (Special Education Technology-BC). Two high school pilots were initiated to meet the diverse needs of learners. They include the use of laptops and SMART Boards (interactive whiteboards) by classroom teachers and some of their students. These are two examples of the small scale pilots the Ministry is presently supporting in hopes of making some sort of

impact without a major change in commitment (M. Ekelund, personal communication, October, 2007).

Discussion

In this study I set out to examine the present technology adoption level and extent of computer and Internet use of by one school district's elementary teachers. I also hoped to gain a better understanding of what the needs and beliefs of this District's elementary teachers were in relation to using technology to meet curriculum requirements; specifically computer and Internet use. There were three guiding research questions for this study. Specifically, the data collected addressed these questions:

1. What types of support do teachers identify as requirements to integrate technology in curriculum activities?
2. What beliefs do teachers hold towards the use of technology to address curriculum outcomes?
3. How do teachers describe their level of proficiency using technology?

Technology Support

As Colbum (2000) questioned, I also wanted to know what kind of supports my District's elementary teachers would identify as needed to integrate technology effectively (p. 14). The data collected shows that 85% of the District's elementary teachers (those that selected the values 4 or 5 on the scale) believe there is a necessity for a school-based technology support person. As well, 79% of the teachers responding (indicated as 4 or 5 on the scale) expressed that their most urgent requirement is to try out technology-enhanced curricula in their classroom to become confident with its use before it is implemented. Presently, 39% of the

teachers identified that they receive 50% or more of their technology information from their peers or colleagues. How might District technology plans incorporate these two identified needs and also acknowledge teachers' reliance on colleagues to gain information about technology? As other researchers have indicated, the isolated atmosphere of a teacher's day may inhibit the move toward integration of technology to support curriculum goals (Becker & Anderson, 1998; McKenzie, 2001; Peck et al., 2002). Within a school setting, school staff members work in isolation in their classrooms for much of their work day. Outside the hours of student instruction, teachers may spend the remainder of their time planning and marking within their own school building. Access to outside assistance with technology may be limited. On an ongoing basis, the teachers' most likely place to observe technology use as well as gain assistance may be from their school-based colleagues. How can this District support their teachers to further utilize technology to meet curriculum goals? Is it financially viable to employ a school-based technology support person?

McKenzie (1999) stated that when "classroom teachers are shown how new technologies can improve the way students learn and think" (p. 2) student learning with technology will increase. The District's elementary teachers recognize the importance of peer interactions and their personal need to experiment with new pedagogy before becoming comfortable. They also believe there is a need for a school-based technology support person. If funds are not available to assign a specific person to fill this role, perhaps the District might direct teachers to their

teacher mentoring program and how it could be accessed to assist in supporting their technology support needs. The program frees-up two teachers for three days to work together on common professional goals. The program could be utilized by School District 28 teachers to begin a support system when they want to further develop their use of technology. The mentoring relationship might be between school-based colleagues or colleagues from different workplaces within the District. However, McKenzie's (1999) reference to "just in time help" may not be met when mentors are not assigned to the same building. On a daily basis, technical issues may crop up, and even after beginning a mentoring relationship, a mentor outside the building may not always be available when needed by their mentoring partner. In the BC Ministry of Education ICIT resource, *Working with Colleagues* (2002), a district model is outlined that includes "A school-based team, where an ICT mentor works with colleagues in their own building..." (p. 15). The model explains three reasons for its recommendation.

When mentors work with colleagues in their own school building, mentors: are available when problems arise and help is needed, are familiar with constraints on and opportunities for ICT use, [and] can work informally with colleagues and enjoy greater flexibility (p. 15).

Teacher Beliefs

Of the teachers surveyed, 81% agree or strongly agree that technology is motivating for students. As well 85% agree or strongly agree that technology can help to accommodate different learning styles. Goodyear and Carlson (2007) found "...in our experience, teachers' beliefs about technology are surprisingly

consistent—regardless of their own technology access or skill level, teachers are positive about the potential benefits of technology integration in classrooms” (p. 60).

The beliefs uncovered in this research are consistent with Goodyear and Carlson’s findings. In their research, Norris, Sullivan, Poirot, and Soloway (2003) found:

“Taken as a whole, these results refute the conventional wisdom that adoption and integration of technology into K-12 classrooms are somehow based upon (or even related to) individual educator attitudes” (p. 11). In this research there was also no significant relationship found between teachers’ beliefs and the time their students spent using computers.

Teachers’ Technology Proficiency and Use

As Wai-kit, Andersson, and Streith (2005) also showed, the District’s elementary teachers agreed that “technology can accommodate different learning styles” and that “the use of technology is motivating for students.” However, on average the elementary teachers I surveyed only have their students use the computer 15-45 minutes each week. As well, 22% of the teachers never have their students use the computer and over 37% have their students use the computer for less than 15 minutes per week. Similarly, data collected by Norris, Sullivan, Poirot, and Soloway (2003) using an online version of the Snapshot Survey found 45% of teachers in their study use computers for less than 15 minutes per week and 14% never use computers (pp. 3, 4). Unlike Wai-kit et al.’s research, my results showed teachers’ recognition of technology’s usefulness in motivating and meeting students learning needs did not relate to the teachers’ use of computers with their students.

However, there was a positive relationship found between the amount of time students spend using the Internet and their teachers' belief that technology use is motivating for students. That is, as teachers' strength in their belief increased, the time students spent on the Internet increased.

Examination of the data also indicated the students' time spent on computers and the Internet that was specified by their teachers, is significantly related to the level of technology adoption the District's teachers have presently reached. That is, as the teachers moved upwards in their adoption stage, their students' use of computers and technology also increased. On average, the District's teachers indicated their adoption of technology at Stage 5, "Adaptation to other contexts." As described in the questionnaire, Stage 5 states, "I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid."

Only 9% of the teachers identified their stage as Stage 6, "Creative application to new contexts." The Stage 6 descriptor states "I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum." In this District, teachers are comfortable with the use of technology but the majority have not moved onto the next stage which would include their students using the technology to explore the curriculum. Presently, the District's teachers' time using technology is at a higher level than student usage at school for curriculum purposes. The District's teachers have indicated they "need to be able to try out technology-enhanced curriculum units in [their] classroom before

[they are] comfortable with them.” This District’s elementary teachers may require more time and opportunity to experiment with new technology before progressing to stage 6.

District Implications

Sandholtz and Reilly (2004) indicated that “without adequate support, teachers may go for years using technology only in limited ways” (p. 492). The teachers in this study have prioritized their needs to support the use of technology in their classrooms. The teachers recognize the value of integrating technology, but may lack the pedagogical skills and knowledge needed to incorporate it into their classrooms. Teachers indicate they need to be able to try out technology-enhanced units to become more proficient and confident using the technology with their students. The teachers require more opportunities to work together to develop curriculum units that incorporate technology. How can this District enhance their technology program to help their elementary teachers move on from Stage 5 adoption to Stage 6? Given enough time, will the teachers progress through the stages of adoption on their own? Previous research has indicated the key to progression through the stages of adoption of technology is professional development (Becker, 2001; Becker & Ravitz, 2001; McKenzie, 2001; Riel & Becker, 2000; Sandholtz & Reilly, 2004). A one and a half day mentoring opportunity may not provide enough support and time to make the change to technology integration in the elementary classrooms.

To encourage the District's teachers to move closer to the description of a Stage 6 technology user, more opportunities should be made available for teachers to work together to support and build their repertoire of technology-enhanced units. Sandholtz and Reilly (2004) stressed the need for professional development in the area of technology to be refocused on support for integration of technology rather than skills development. "Content and curriculum come first, and technology is available to support the instructional and learning goals of the district" (p. 510). McKenzie (2001) suggested that professional development focus on how adults learn and emphasize curriculum and literacy, not computer networks and software. His approach includes a focus on strategies and projects that have teachers learning together in informal groups with technology support staff. McKenzie also advocates districts supporting their teachers in ways that reduce their isolation as they develop lessons that integrate new technologies. The resource *Working with Colleagues* (Ministry of Education, BC, 2002) provides numerous suggestions on how to plan an ICTI mentorship program in a district.

Barnes (2005) suggested that when teachers are facing changes in pedagogy and curriculum content, support needs to come in the form of professional development opportunities that provide teachers with time to reflect and learn by doing. The District's mentoring program could be expanded to encourage mentoring relationships beyond the one and a half days each year presently allocated. The District's technology plans could also be enhanced to support peer coaching opportunities. It may be appropriate to reinstate the District's technology

focus group model of the past. The model provided interested teachers with regularly scheduled after-school opportunities to share and learn from each other's personal technology experiences with their students.

Researchers have also indicated the assumption that the integration of technology will occur without leadership is flawed (Ertmer, 2005; Karagiorgi, 2005; Wai-Kit; Andersson, & Streith, 2005). The leaders in technology in the District could be utilized to support teachers as they adapt their practices to integrate technology. This leadership can take many forms including, initiating school-based peer support, developing focus groups, creating school-based technology committees, offering to share their experiences by conducting District workshops, and participation on professional development committees or a District technology committee.

O'Bannon and Judges (2004-2005) advised that support that promotes high-quality technology use for teachers should also include professional development activities in their own school and a support system that includes time for collaboration with peers as well as technical assistance. In this District, a school-based model of technology committees could be introduced so that individual schools could make informative decisions and school-based technology plans, as well as recommendations to a District technology committee. The District's professional development committee could be expanded to include a representative from a District technology committee. The professional development committee and a District technology committee could work together to foster opportunities for

teachers to collaborate and reflect as they begin to integrate technology in their classrooms. Teachers may need to see lessons modeled and have the flexibility to choose activities of interest (Ringstaff & Yocam, 1994). In one district, Sandholtz and Reilly found "Technology use throughout the district is part of a comprehensive plan that encourages collaboration among teachers and allows them to share ideas and techniques for integrating technology into their teaching" (p. 510).

Limitations

Limitations of external validity are present in this study. The presentation of the questionnaire to only elementary teachers, teacher librarians, and learning resource teachers in one small urban school district limits generalizability to other urban school districts as well as other teacher populations within the same district. Future data collection could be expanded to include other teaching populations and school-based administrators in this District that were excluded from the current study. The data from this study do not allow the researcher to conclude whether the respondents are a representative sample of both reluctant users of technology and proponents of technology use in elementary classrooms. Another study that insured inclusion of all elementary teaching staff would increase the validity of the conclusions reached by the researcher.

Some of the questions included in the questionnaire may have been open to interpretation. For example, the section where respondents were asked to identify where they received their information about technology did not include an "other" category for those who did not identify with the six specific choices given. The

questionnaire used in the study was created in 1998. Teachers have continued to advance their skills since that time. The rating scale used to determine both the teachers' time using of computers and Internet as well as their students' time may no longer be appropriate. For example the choice "e" (more than 90 minutes per week) did not allow this researcher to determine the difference between those who use the computer for 90 minutes each week and those who might use it for six hours each week. The use of Norris and Soloway's Six Stages of Technology Adoption Scale (1998) may no longer be applicable to the stages teachers in 2007 are working through considering the advances in technology as well as expectations in the area of communications. Although instructions to the respondents included contact information to obtain answers to questions, no respondent contacted the researcher for clarification of any of the questions. A pilot test of the survey would have allowed the researcher an opportunity to make modifications that would have decreased the possibility of misinterpretations. As well a pilot test may have helped to determine what updates needed to be made to reflect the changes in teachers' skills and technology advances that have occurred since 1998.

The exclusion of open-ended questions did not allow participants to add additional beliefs and needs not represented by the questionnaire used for my study. Future research could provide individual teachers the opportunity to include their personal commentary and the inclusion of addition variables that may describe needs and beliefs related to their level of technology integration not identified by me.

Future Research

Teachers in this study were not asked to explain the reasons behind their level of technology integration in their classrooms. Instead the intention, with this first examination of technology use in this District, was to gain a measure of understanding of teachers' present use, their belief in technology's future importance, and their needs for continued use of computers and the Internet in their classrooms. Becker (2001) suggested one predictor of high-level uses of technology was constructivist-compatible instruction. An examination of elementary teachers' pedagogical beliefs and its relationship to their level of technology integration could be a focus of future research. Data from such research may assist the technology committee and professional development committee to connect their District teachers' level of technology use and pedagogical practices with the types of professional development activities provided.

Further exploration of the connection between the District's teachers' beliefs in the usefulness of technology to meet curriculum outcomes could also be a focus of future research. Wai-kit, Andersson, and Streith (2005) suggested that teachers "intention towards technology use" (p. 392) is affected by their belief in the usefulness of computer technology to meet curriculum outcomes. Sime and Priestley (2005) observed that the attitude of a teachers' community towards ICT use also influenced the level of technology use in the classroom. This District's technology coordinator, M. Ekelund, suggested that the present level of technology use in the District may be related to the lack of direction the Education Ministry has

given to its teachers in the area of technology use in the elementary classroom (personal communication, October, 2007). Are teachers' beliefs in the usefulness of technology in the classroom influenced by their community's beliefs (Education Ministry, parents, colleagues, and district administrators)? Further investigation might also ask the question, first suggested by Wai-kit, Andersson, and Streith, is the lack of technology integration related to a setting where technology use is not mandatory? Is there merit to the theory purposed by M. Ekelund that teachers view technology use as an add-on, and therefore do not have the time required to integrate technology substantially when its use is not mandated by their community (personal communication, October, 2007)?

An area not examined closely in this report is the influence access to technology has on the level of integration of technology in curriculum. Norris, Sullivan, Poirot, and Soloway (2003) concluded that "Clearly, teachers cannot employ educational technology to which they have minimal or no access, let alone integrate that technology seamlessly into curricular activities" (p. 6). Of the teachers responding to my survey 78% indicated they have no more than one computer connected to the Internet in their classroom. In the Norris, Sullivan, Poirot, and Soloway study, access to computers for teachers was somewhat less limiting with 63% of its teachers indicating they had no more than one computer to share with their students in their classroom. Therefore, although 99% of this District's elementary teachers responding stated that they have access to at least one classroom computer and a lab of 24-30 computers, the question remains whether this is adequate to

enable the integration of that technology into the curriculum? To what level access to computers should be increased is a question worthy of exploration, and the effects of that integration of technology is a worthwhile question. Further consideration might need to be paid to one researcher's findings, "...that teachers' use of technology for curricular purposes is almost exclusively a function of their access to that technology" (Norris et al., 2003, p. 11).

Conclusion

A review of some of the research conducted on technology use in the classroom provides a volume of material. Researchers have explored how it is used, can be used, why it is not being used more, and connections have been made to teachers' belief systems, access, and whether or not technology should be used at all. In this project, I conducted a preliminary exploration of one District's present use of technology by its elementary teachers and their students. Computers are likely to continue to be part of teachers' and their students' lives whether in school, at home, or at work. Further research is required to ascertain whether or not learning with technology has any greater usefulness than traditional methods to meet curriculum requirements. As well, how and whether elementary teachers in this District will progress through the stages of technology adoption will require continued observation. At the present time, is this District's response to requests and "planting seeds" (M. Ekelund, personal communication, October, 2007) all that is necessary as well as fiscally possible in the area of technology use in its elementary schools? The BC Ministry of education has not developed a stand-alone elementary technology

curriculum. On close examination of each curriculum guide and the PLOs, recommendation of technology integration is included. Does this explain why the majority of teachers are not using technology with their students? Is learning with technology an “add-on” that can be ignored by some educators and employed by others who for personal reasons see it as a useful tool to enhance their pedagogy? The data from the survey conducted do not indicate this. Instead that data showed teachers have technical skills and the belief that technology is useful. Perhaps what is lacking is the knowledge and confidence to implement the strategies suggested in the Ministry ICTI Performance Standards document (BC Ministry of Education, 2005). Perhaps the survey I have conducted has helped to begin discussion that may help to enhance one District’s future technology plans. District technology plans might now be made with an improved understanding of some of the support needs and beliefs of its elementary teachers. This enhanced understanding might begin to address the concept of learning with technology as teachers continue to meet the prescribed outcomes of the elementary school curriculum.

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APPENDICES

Appendix I
Survey Protocol**Assessment of Technology Use by Elementary Teachers**Modified Version 3.1b from the Teachers & Technology: A Snap-Shot Survey
Sponsored by: Texas Center for Educational Technology

Please take a moment to fill out this short questionnaire. The questionnaire provides a snapshot of how prevalent technology is in education today, and what you, as an educator, believe about the technology.

Participation in this study is voluntary. You have the right to answer only the questions you choose. You may withdraw at any time from the study and to withdraw any information that you previously provided to the researcher.

Identification Number: # .00

Demographics:**Teaching Responsibility (Check all that apply):****Age:****Gender:**

<input type="checkbox"/> K	<input type="checkbox"/> Grades 4-7	<input type="checkbox"/> 20-29	<input type="checkbox"/> male
<input type="checkbox"/> K/1	<input type="checkbox"/> Other Grade Configuration	<input type="checkbox"/> 30-39	<input type="checkbox"/> female
<input type="checkbox"/> Grades 1-3	<input type="checkbox"/> Teacher Librarian	<input type="checkbox"/> 40-49	
<input type="checkbox"/> Grades 3/4	<input type="checkbox"/> Learning Resource Teacher	<input type="checkbox"/> over 50	

Do you have a computer **at home** that you use for profession-related:

☐ email ☐ Internet ☐ other professional activities

Do you have a computer **at school** that you use for profession-related:

☐ email ☐ Internet ☐ other professional activities

Do you have a computer **at home** that you use for personal

☐ email ☐ Internet ☐ other activities

The percentage of the information you receive about teaching with technology is from:

(Estimate the amount for each category)

<input type="text"/> % Conferences	<input type="text"/> % Research Journals
<input type="text"/> % Peers/Colleagues	<input type="text"/> % District Technology Personal
<input type="text"/> % Teacher magazines	<input type="text"/> % Internet

What, if anything, do you need to make technology an integral part of your classroom's curricular activities?

Please use the numbers 1-5 where 1 represents a less urgent need and 5 represents a more urgent need.

	Less Urgent			More Urgent	
1. I need more time to learn to use computers and the Internet.	1	2	3	4	5
2. I need more time to adjust my teaching practices to incorporate new technology.	1	2	3	4	5
3. I need more training with technology. (computer programs, LCD projector, United Streaming etc.)	1	2	3	4	5
4. I need more training with curriculum and pedagogy that integrates technology.	1	2	3	4	5
5. I need more access to computers for my students.	1	2	3	4	5
6. I need more access to the Internet for my students.	1	2	3	4	5
7. I need more software that is curricular-based.	1	2	3	4	5
8. I need more technical support to keep the computers working.	1	2	3	4	5
9. I need more resources that illustrate how to integrate technology into the curriculum.	1	2	3	4	5
10. I need to be able to try out technology-enhanced curriculum units in my classroom before I am comfortable with them.	1	2	3	4	5
11. I need more opportunities to work with colleagues to become proficient using technology-enhanced curriculum units.	1	2	3	4	5
12. I need more compelling reasons why I should incorporate technology into the classroom.	1	2	3	4	5

Please circle the number that best reflects your belief, where 1 = Strongly Disagree, 3 = No Opinion, and 5 = Strongly Agree.

	SD			SA	
1. I believe that traditional print sources will be replaced by electronic media within 5 years.	1	2	3	4	5
2. I believe that the role of schools will be dramatically changed because of the Internet within 5 years.	1	2	3	4	5
3. I believe that the role of the teacher will be dramatically changed because of the Internet within 5 years.	1	2	3	4	5

	SD			SA	
	1	2	3	4	5
4. I believe that the role of the teacher will be dramatically changed because of new technologies within 5 years.					
5. I believe that I am a better teacher with technology.	1	2	3	4	5
6. I take personal time to learn and practice technology skills.	1	2	3	4	5
7. I believe there is a need for a school-based technology support personnel.	1	2	3	4	5
8. I find the use of technology to be motivating for students.	1	2	3	4	5
9. Student time on the Internet is time well spent.	1	2	3	4	5
10. Technology can help accommodate different learning styles.	1	2	3	4	5

Teachers: Please respond as it relates to your classroom and school.

_____ Number of computers per classroom _____ Number of computers per lab
 _____ Internet connections per classroom _____ Internet connections per lab

Teachers: Please identify the amount of time spent on each of the following activities by placing a checkmark next to the statement that best represents your teaching circumstance.

- | | |
|--|---|
| <p>1. Students engage in computer-based activities (but not Internet use) for curricular purposes:</p> <p>a. _____ 0 minutes per week
 b. _____ Less than 15 minutes per week
 c. _____ 15 – 45 minutes per week
 d. _____ 46 – 90 minutes per week
 e. _____ More than 90 minutes per week</p> | <p>3. I use the computer (but not the Internet) in my teaching/administrative activities:</p> <p>a. _____ 0 minutes per week
 b. _____ Less than 15 minutes per week
 c. _____ 15 – 45 minutes per week
 d. _____ 46 – 90 minutes per week
 e. _____ More than 90 minutes per week</p> |
| <p>2. Students engage in Internet-based activities for curricular purposes:</p> <p>a. _____ 0 minutes per week
 b. _____ Less than 15 minutes per week
 c. _____ 15 – 45 minutes per week
 d. _____ 46 – 90 minutes per week
 e. _____ More than 90 minutes per week</p> | <p>4. I use the Internet in my teaching/administrative activities:</p> <p>a. _____ 0 minutes per week
 b. _____ Less than 15 minutes per week
 c. _____ 15 – 45 minutes per week
 d. _____ 46 – 90 minutes per week
 e. _____ More than 90 minutes per week</p> |

Please read the descriptions of each of the six stages related to the adoption of technology, and then circle the number of the stage that best describes your level.

Stage 1: Awareness

I am aware that technology exists but have not used it, perhaps I'm even avoiding it.

Stage 2: Learning the process

I am currently trying to learn the basics. I am sometimes frustrated using computers. I lack confidence when using computers.

Stage 3: Understanding and application

I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.

Stage 4: Familiarity and confidence

I am gaining a sense of confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.

Stage 5: Adaptation to other contexts

I think about the computer as a tool to help me and am no longer concerned about it as technology. I can use it in many applications and as an instructional aid.

Stage 6: Creative application to new contexts

I can apply what I know about technology in the classroom. I am able to use it as an instructional tool and integrate it into the curriculum.

Appendix II

RESEARCH PROPOSAL SUMMARY

How Can Technology Integration be Fostered in the Elementary Classroom?

SUBMITTED TO: School District #28 (Quesnel)
401 North Star Road
Quesnel, BC
V2J 5K2
Attention: Ms Miller, Superintendent

SUBMITTED BY: Judy Minion
3049 Venture Rd.
Quesnel, BC
V2J 6P8

Introduction

Since the introduction of the personal home computer over twenty-five years ago, expectations have been placed on teachers to use technology in their classrooms. However, educators continue to discuss not only how this integration should take place but also whether it is needed. No matter what technology advances occur, the underlying goal of educators continues to be student learning. Can, and should, technology integration be used to help educators meet curriculum goals? Financial support in the way of up-to-date technology tools continues to be available. Does elementary teaching staff find the continued acquisition of more technology tools adequate to support technology integration in their classrooms? Informal conversations about student achievement, technology use in schools, teacher readiness to meet the demands of the growing integration of technology in our world, and how these concerns are connected continue.

Research in the area of technology integration indicates educators and parents believe technology is a vital part of providing premium education (Becker, 2001; Ertmer, 2005; Liu & Huang, 2005; Wai-kit, Andersson, & Streith, 2005). If high-

quality education includes the integration of technology in the curriculum of today's classrooms, then why has technology use in schools been described as under utilized? Has the support given to technology tools been adequate? Could money have been allocated for technology differently? In his book *Oversold and Underused*, Cuban (2001) states, "Although there is much talk of respecting teacher expertise, recognizing exemplary teachers, and appointing occasional teachers to blue-ribbon commissions, most teachers historically have had little say in designing and implementing technology plans"(pp. 183-184). Rather than continuing to fund only the acquisition of newer and "better" technologies, perhaps it is time to ask teachers what additional sources of support they need in order to effectively integrate technology in their classrooms

Purpose

When a school district constructs its technology plan, consideration should be given to not only what technology equipment is needed in its schools but also what human infrastructure is required to support its use by teachers and their students (McKenzie, 1999). Teachers could be asked what they require to implement the use of new technologies. Classroom teachers' voices may help to strike a balance between available technology resources and support structures to assist them in finding ways to integrate the technologies that will reinforce student learning. This project will survey one district's elementary teachers to gather data in the areas of their level of competency using technology, their beliefs related to technology use by themselves and their students, and support requirements needed to integrate technology in the curriculum.

Research Population

The target population of this project is the elementary teaching staff in the researcher's school district. Those choosing to respond to the questionnaire will constitute the sample. The participants will be provided with a written description of the purpose of the project prior to their completion of the survey. The survey will

be distributed in September 2007 with data collection completed by the end of October 2007.

Procedure

In September 2007, a survey (see enclosures) will be sent out to all elementary teaching staff, teacher librarians, and learning resource teachers via school mail. The survey will seek to gather data that will indicate the present level of teachers' technology skills, their beliefs towards technology use for professional purposes and student use and the support they believe would be required to encourage a high-level of technology integration in elementary schools. An introductory letter will accompany each questionnaire. The cover letter (see enclosures) will explain the purpose of the project and a brief explanation of the data analysis planned. Participants will be encouraged to direct any queries regarding the questionnaire to the researcher via district email or by telephone.

A one-on-one interview with the School District #28 Technology Coordinator will also be conducted to provide background information relevant to the researcher's district's technology plan and focus. During the interview, the coordinator will also be asked to comment on the funding structure for technology tools and support in the district. Data from this interview will provide the researcher with the district's present technology goals and past technology focus. Using the data collected from the survey and this interview, a comparison of the district's technology focus and the teachers' beliefs around the integration of technology could be made.

Ethical Considerations

The purpose of the research project will be fully disclosed to the participants in the study. Data will be gathered through questionnaires with School District #28 elementary teaching staff. As such, a letter of permission to conduct the study is requested from the School District Board through its Superintendent. Participation in the project will be voluntary. Participants will be free to decline or withdraw

from the research at any time. Because all the participants in the project will be members of the BCTF, its code of ethics will be respected.

Cover letters included with the questionnaire describe how the data will be collected and used for the purpose of this UNBC MEd research project. Participants will be assured that their participation in the project will not place them at risk personally or professionally. The teachers and Technology Coordinator will be asked to sign a statement indicating that they have given their informed consent to participate in the study (see enclosures).

The data collected will be kept in a secure location and participants' names will not be included as part of the demographics collected. Participants will indicate on the consent form their desire to view results at the completion of the data collection and analysis. They will also be invited to request a copy of the final project report via email or by telephoning the researcher.

Results

Results will be reported in a formal research report and possibly in subsequent professional journals and presentations. A copy of the formal report can be obtained from the researcher by participants, the Superintendent of School District #28, and any other interested parties.

Judy Minion, UNBC Graduate Student

Dr. Bryan Hartman
Committee Supervisor

Appendix III

LETTER OF EXPLANATION AND CONSENT FOR RESEARCH

July, 2007

Superintendent of Instruction
School District #28 (Quesnel)
401 North Star Road
Quesnel, BC
V2J 5K2

Dear Ms Miller,

As you know, I am a MEd student at the University of Northern British Columbia. Attached to this letter is a summary of my research proposal for a project on the topic of technology integration by elementary teachers.

I am requesting permission to conduct this study in School District #28. Please contact me if you require any additional information.

Sincerely,

Judy Minion
Email: judy@sd28.bc.ca
Home 747-4595
School 992-5421

6 Enclosures:

- Research Proposal Summary
- Copy of Teacher explanation letter
- Copy of Teacher consent form
- Copy of Technology Coordinator explanation letter
- Copy of Technology Coordinator consent form
- Copy of Survey Protocol

Appendix IV

LETTER OF INFORMATION FOR TEACHERS

September 2007

Dear Teachers/Teacher Librarians,

I am requesting your participation in a UNBC MEd study of the integration of technology in the elementary curriculum by completing the enclosed survey questionnaire. My goal is to attain teachers' understanding of the extent to which technology is being integrated by School District #28 elementary teachers and students to support curriculum learning outcomes. As well, I am interested in gathering teachers' opinions on classroom-technology-related needs and beliefs. It is my desire that this study will provide data that will help those responsible for the district's technology plan to focus resources where teachers believe they are needed most.

If you agree to participate in this study, please take a few minutes to fill out and return the enclosed survey. Please indicate on the accompanying letter of consent your agreement to participate in the study.

A survey has been mailed out to all elementary teachers, elementary teacher-librarians, and elementary resource teachers in District #28. Data collection will take place in September and October 2007. A self-addressed envelope has been included with the survey to facilitate its return.

The data collected will be kept in a secure location and your name will not be included as part of the demographics collected. All data collected for this research

project will be accessible only to me and my committee supervisors. Once the data are collated and analyzed, the original surveys will be shredded and discarded. This process should be complete within one year of original collection. Please indicate on the teacher consent form your wish to view results at the completion of the data collection and analysis. You may also request an email copy of the final project report.

Information from this project will be used for my MEd report, and may also be used for research reports and professional presentations. No names of participants will be disclosed. Demographic information will be shared in order to provide context for readers and facilitate data analysis. There is no risk or negative effect of participation in this study. Participation is completely voluntary and you may withdraw from the study at any time and for any reason without repercussion.

If you have any concerns or further questions regarding this project please contact me. Any complaints about the project should be direct to the Office of Research, 960-5820 or by email: reb@unbc.ca.

Thank you for considering participating in my UNBC MEd project. Your response is appreciated.

Sincerely,

Judy Minion

UNBC Graduate Student/Researcher

School Phone: 992-5421

Email: judyminion@sd28.bc.ca

Appendix V

LETTER OF INFORMATION FOR DISTRICT TECHNOLOGY COORDINATOR

September 2007

Dear Mr. Ekelund,

I am requesting your participation in a UNBC MEd study of the integration of technology in the elementary curriculum by agreeing to be interviewed. The goal of the study is to attain teachers' understanding of the extent to which technology is being integrated by School District #28 elementary teachers and students to support curriculum learning outcomes. As well, I am interested in gathering teachers' opinions on classroom-technology-related needs and beliefs. It is my desire that this study will provide data that will help those responsible for the district's technology plan to focus resources where teachers believe they are needed most.

If you agree to participate in this study, I request the opportunity to interview you about the district's technology plan and initiatives to support the integration of technology. Specifically, I will ask you a number of questions to gain an understanding of the past and present focus of the use of technology in the elementary curriculum. I will prepare a number of questions that will seek to comprehend the level and type of support available to elementary teachers as they address technology integration in the curriculum. If you wish, the questions to be used to open discussion can be provided to you before the interview via email.

In addition to the interview with you, a survey will be mailed out to all elementary teachers and elementary teacher-librarians in District #28. Data collection will take place in September and October 2007. I request that the interview with you be conducted during this time period as well. Collection and analysis of the interview data will be facilitated by notetaking and digital recording. These notes and audio files will be accessible only to me, you, and my committee supervisors. Information from this project will be used for my MEd report, and may also be used for research reports and professional presentations. In the report, the name of the district and your name will not be disclosed. However, demographic information and setting descriptions will be shared in order to provide context for the reader. As well, the researcher's name will be included on all reports. Because you are the only District Technology Coordinator in the district included in the study, there is the possibility that readers may be able to identify you. Therefore, you will be given the opportunity to review the results of the interview and approve the relevant contents

included in the report before it is submitted to my supervisory committee. There should be no risk or negative effects of your participation in the study.

Participation is completely voluntary, and you may withdraw from the study at any time and for any reason without repercussion.

If you have any concerns or further questions regarding this project please contact me. Any complaints about the project should be direct to the Office of Research, 960-5820 or by email: reb@unbc.ca

Thank you for considering participating in my UNBC MEd project. I look forward to talking with you.

Sincerely,

Judy Minion

UNBC Graduate Student/Researcher

School Phone: 992-5421

Email: judyminion@sd28.bc.ca

Appendix VI

UNBC REB APPROVAL LETTER

UNIVERSITY OF NORTHERN BRITISH COLUMBIA

RESEARCH ETHICS BOARD

MEMORANDUM

To: Judy Minion
CC: Bryan Hartman

From: Greg Halseth, Acting Chair
Research Ethics Board

Date: September 18, 2007

Re: **E2007.0808.083**
How to support technology integration in the elementary classroom

Thank you for submitting the above-noted research proposal and requested amendments to the Research Ethics Board (REB). Your proposal has been approved.

We are pleased to issue approval for the above named study for a period of 12 months from the date of this letter. Continuation beyond that date will require further review and renewal of REB approval. Any changes or amendments to the protocol or consent form must be approved by the Research Ethics Board.

Good luck with your research.

Sincerely,

Greg Halseth

Appendix VII

Survey Use Consents

Texas Center for Educational Technology

<http://www.tcet.unt.edu/home/>

Contact Information: Last Updated 2006-06-23

TCET

P.O. Box 305280

Denton, TX 76203-5280

Phone: (940) 565-4433

TTY: (800) Relay TX

email: [tcet \(at\) unt.edu](mailto:tcet@unt.edu) Questions, comments or suggestions for this site

RSS FEED: <http://www.tcet.unt.edu/home/xml-rss2.php>

Powered by NucleusCMS.

Research Instrument Use (inactive site)

<http://www.tcet.unt.edu/research/instrumt.htm>

Instruments not developed by TCET are clearly marked with contact information. Instruments developed by TCET may be used for educational research purposes as long as the source is clearly noted. TCET (tcet@unt.edu) requests that you contribute to our research database by emailing the following information at the beginning of your study:

- name and email address of the lead investigator
- purpose of the study
- name of the instrument which you will be using
- approximate completion date
- type and approximate number of subjects

In addition, TCET requests that you send a copy of any publications resulting from the use of these instruments to PO Box 311337, Denton, TX 76203-1337 with written permission to use parts within future research studies.

June 30, 2007

Dear Ms Norris,

My name is Judy Minion. I am a teacher in the Quesnel School District in British Columbia, Canada. Presently I am working on my Master in Educational Leadership. I am preparing my proposal for my project. My topic is technology integration (or lack of) in elementary schools. My working title is The Technology Connected Classroom of Today: How Technology Integration can be Fostered in the Elementary Classroom. I intend to conduct a survey of all elementary teachers in my district (approximately 150) regarding their use of, beliefs around, and needed support to integrate technology to promote student achievement. I am writing to you to gain permission to modifying and add to the questionnaire developed by Norris and Soloway in 1998 as a data collection device for my project. The survey I am referring to, Teachers & Technology: A Snap-Shot Survey, was found at <http://www.tcet.unt.edu/research/instrumt.htm>

If I have contacted the wrong person to gain such permission, would you please forward this email to someone who could assist me.

Thank you,
Judy Minion

Email Reply

Received July 19, 2007

Hi Judy,

I apologize for the delayed response to your inquiry, but your request was caught by the spam filter at the university mail system and I just found it in the "junk" folder. You do have my permission to use and modify our survey if you would share your results with me. I would love to see how much or how little things have changed since we did the survey.

Sincerely,

Cathleen Norris
Regents Professor
Department of Technology and Cognition
University of North Texas
PO Box 311335
Denton, Texas 76203
Office: 940-565-4189
Fax: 940-650-2012
norris@unt.edu

Appendix VIII

TECHNOLOGY COORDINATOR CONSENT FORM

- ☐ I have read the accompanying Letter of Explanation for the Technology Coordinator and the Proposal Summary. I understand what I have read and agree to participate in the research study examining the use of technology in the elementary curriculum.
- ☐ I understand that my anonymity is protected in any writing or publications resulting from this study
- ☐ I understand that access to the raw data collected will be accessible to the researcher and her supervisors only
- ☐ I understand the benefits and risks involved in participating in this study.
- ☐ I understand that if I have any questions or wish to discuss this study, I can contact the researcher.
- ☐ I understand that my participation is voluntary, and that I can withdraw from this study at any time.
- ☐ I would like a copy of the research results at the completion of the study.

This study was explained by:

Print Name

Signature of Research Participant

Date

Printed Name of the Research Participant

I believe that the person signing this form understands what is involve in the study and voluntarily agrees to participate.

Signature of Investigator

Date

Appendix IX

TEACHER CONSENT FORM

- ☐ I have read the accompanying Letter of Explanation for Teachers. I understand what I have read and agree to participate in the research study examining the use of technology in the elementary curriculum.
- ☐ I understand that my anonymity is protected in any writing or publications resulting from this study
- ☐ I understand that access to the raw data collected will be accessible to the researcher and her supervisors only
- ☐ I understand the benefits and risks involved in participating in this study.
- ☐ I understand that if I have any questions or wish to discuss this study, I can contact the researcher.
- ☐ I understand that my participation is voluntary, and that I can withdraw from this study at any time.
- ☐ I would like a copy of the research results at the completion of the study.

This study was explained to me in a letter written by the researcher, Judy Minion.

Signature of Research Participant

Date

Printed Name of the Research Participant

I believe that the person signing this form understands what is involve in the study and voluntarily agrees to participate.

Signature of Investigator

Date